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The organizational choice of public good provision

Chia-yen Yang
Iowa State University

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The organizational choice of public good provision

by

Chia-yen Yang

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Chia-Yen Yang

has met the dissertation requirements of Iowa State University

Signature was redacted for privacy.

Major Professor

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For the Major Program

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For the Graduate College

To the memory of my grandmother, Bo-Chu,

to the belief in me of my wife, Lih-Jen,

and

to the hope for my daughter, Emma.

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ABSTRACT

This dissertation maintains that organizational efficiency and interest competition are the two primary forces of institutional formation for the public good provision. On the one hand, efficient institutions are in principle desirable, since they bring about potential gains for the involved interests as a whole. On the other, interest conflict in distributing the potential gains may lead to the emergence of some alternatives that appear relatively inefficient. The perceived institutional inefficiency, however, comes from neglecting the fact that settling distribution disputes is frequently costly in the human society.

In this dissertation, a comprehensive organizational classification is proposed in terms of ownership arrangement. This classification is comprehensive in the sense that all institutions can be categorized in a theoretically thorough framework. It facilitates the comparison of organizational efficiencies and identification of the beneficiary and harmed under main institutional alternatives. Analysis in the relative advantages/disadvantages of institutions under different situations leads to the conclusion of several general principles for the institutional patterns of the public good provision.

When use exclusion is relatively easy, difficulties in market transacting or ownership exercising affect the determination of organizational arrangements, which aim at mitigating the associated difficulties. That is, total costs associated with transacting and ownership decide whether the public good provision would be done through producer-owned firms, customer cooperatives, member-controlled organizations (including governments), producer-owned firms under government regulations, or nonprofits. On the other hand, non-excludability problem may be solved by tie-in transactions or by indirect transaction via a third party. Such contractual arrangements do not require direct governmental involvement. Non-excludability may also be resolved by establishing formal/informal rules for use

exclusion and/or income right to the provided service. Establishment of such property right institutions always involves customer ownership of some forms. Therefore, difficulties/costs associated with collective decision-making by diverse interests serve as the key determinant to the final outcome of public good provision.

Finally, the empirical study focus on three types of dams: navigation, wildlife conservation, and flood control. Based on the theory proposed in this dissertation, some hypotheses for the ownership patterns of dams are derived and tested for the evaluation of my theoretical underpinnings. Empirical evidences are found strongly supportive.

1. INTRODUCTION

Since Samuelson (1954) raised the concerns about the efficiency problem in providing public goods, studies on the general principle for the provision of public goods have been rapidly growing. Cornes and Sandler (1996) have made the major contribution to the survey of the literature in this field. On the other hand, controversies and debates seem inevitable as usual. Cowen (1988) and Foldvary (1994), notably, have been devoted to the collection of those challenging arguments. Disputes commonly center on whether "government intervention" is generally desirable for the provision of public goods.

The famous Samuelson condition stimulated some considerations, which has led to the caution of the "nirvana" fallacy, that any social planner also faces constraints. The concept of "constrained Pareto optimum" has started to take its place. To evaluate the performances of organizational and institutional alternatives, a researcher needs to identify and include the relevant underlying constraints, which confine the benefit-maximizing actors to a limited range of choices. In other words, it is inappropriate to contrast reality with ideality against any organizational arrangement.

Inspired by Coase (1937, 1960), so-called "new institutional economists" have consistently argued that efficiency comparison among alternatives be one key to understand the organizational and institutional arrangements.[1] In principle, institutional efficiency is desirable, since it brings about potential gain for the involved interests as a whole. On the other hand, distribution of the resulting gain may involve intense competition among different interests, which has also been recognized as the primary factor of institutional formation and

[1] Cheung (1992) provided a readable discussion on the new institutional economics. For more detailed literature review, see Eggertsson (1990), and Furubotn and Richter (1997).

change, as shown in works by North (1981, 1990), Olson (1982), Libecap (1989), and many others. In their view, interest conflict in distributing the potential gains may lead to the emergence of some alternatives that appear relatively inefficient. The perceived institutional inefficiency, however, comes from implicitly assuming that settling distribution disputes is costless. As we know, reality does not support this assumption. Nonetheless, both efficiency comparison and interest competition will be maintained in this dissertation as the two keys to the analysis of institutional formation and change.

One fundamental question remains – how can we exhaust all possible organizational and institutional forms for comparing their efficiencies and net benefit distributions? Recently, Hansmann (1996) has made the path-breaking contribution to the generalization of organizational patterns in terms of ownership structure. In my view, Hansmann's work significantly facilitates investigation on the organizational choice of public good provision. With some extension, all institutional and organizational alternatives can be classified within a unified analytical framework. Within this comprehensive framework, the organizational efficiencies of major institutional alternatives can be placed into comparison. The beneficiary and the harmed groups can also be identified. Investigating the potential gain from organizational efficiency and interest competition for its distribution will help predict the emergence of institutional and organizational arrangements.

The purposes of this dissertation are as follows. First, I shall argue and demonstrate how economic analysis can benefit from placing the properties of the public good into a choice-theoretic framework. Within this framework, we can explain and predict whether and what kind of public goods will be provided, both of which are the integral parts of the problem of public good provision. Inquiries based on this viewpoint are very limited in number.

Secondly, this dissertation will extend Hansmann's organizational classification to a comprehensive one so that all institutions and organizations can be included. I shall argue that, based on the concepts of property rights and transaction costs, this extended perspective allows us to investigate all organizational arrangements of production and exchange in a systematic and thorough fashion. That is, this perspective transcends the previous controversies, resulting arguably from the ambiguous distinction between "market-based" and "governmental intervention."

Next, this dissertation will attempt to derive the general principles of organizational choice of public good provision. Based on various kinds of possible difficulties in the process of production and exchange, the advantages and viability of different organizational arrangements will be hypothesized and summarized.

Finally, an empirical study will be conducted in the ownership patterns of the dams primary for navigation, flood control, and fish-wildlife conservation. Some theoretical conclusions in my analysis will be formulated into ten testable hypotheses. These ten hypotheses will then be evaluated against the empirical evidences. As we shall see in chapter 6, those theoretical conclusions are strongly supported by the empirical evidences.

The organization of this dissertation is as follows. In chapter 2, a critical literature review is presented. Discussion on non-rivalry and its social construction (endogeneity) is then given in chapter 3. A theoretical foundation of organizational choice is elaborated in chapter 4. A simple formal model then follows. In chapter 6, an empirical study is presented. Finally, conclusion and limitation of this research will be discussed.

2. CRITICAL LITERATURE REVIEW

While the large literature of common pool resources evidently reveals the exclusive rules and their enforcement as the objects of choice, little attention has been paid to the social construction of non-rivalry characteristic. The latter is nonetheless the integral part of the public-good problem.

Specialization and division of labor are commonly known as the primary source of productivity increase. To realize the tremendous benefits, resources owned by different individuals have to be organized for the purposes of production and exchange. This practice inevitably generates the needs of delineating, exercising, and protecting individual property rights to the collective resources and benefits. These activities incur costs, which are commonly termed transaction costs in economics. Hence, to study human organizational choice, including that for public good provision, property rights and transaction costs serve as two germane concepts.

The literature of industrial organizations in general paid little attention to the problem of collective decision-making by the involved interests within an organization. In contrast, the literature of public choice and common pool resources has forcefully revealed its importance in determining the success of any collective action. When an organization is collectively owned by a group of individuals, the issues of collective decision-making is unavoidable.

This leads us to go on discussing the problem of competition among interest groups. To investigate interest competition, it is fundamental to identify the major actors and their distinctive positions regarding institutional arrangements. Moreover, the competitive advantages/disadvantages of different interests vary under different circumstances. It is

important to examine under what conditions certain class of interest(s) will become more influential and successful.

Hence, this review is planned to cover the following topics: (1) socially constructed non-rivalry, (2) non-excludability and excludability, (3) property rights and transaction costs, (4) costs of collective decision-making, (4) organizations from the perspective of ownership structure by Hansmann (1996), and (5) competition among different interests.

2.1. Socially Constructed Non-Rivalry

The debate among Malkin and Wildavsky (1991), and Cornes and Sandler (1994a) has raised the interesting issue on the "endogeneity" of public good properties. In other words, the public-good properties do not necessarily result from inherent physical nature or technological constraint; they can also originate from people's choice. Take a group trip for example. If group members agree to rent a tour bus together instead of driving their own vehicles, the public nature of transportation is then created. As another example, a group of students may decide that each specializes in individual parts of an assignment so as to save time and raise quality. The resulting gain from the teamwork carries the feature of non-rivalry, generated from students' choice. To study the problem of public good provision, we should investigate first why people initially choose to create the incentive structure of public goods when they can do otherwise.

2.2. Non-Excludability and Excludability

In the world of resource scarcity, exclusion of others from own resources is a significant part of human competitive behaviors. In a society without established rules and orders, human beings can exclude others from the resources they hold by violence: force

guarantees excludability of a resource. On the other hand, in a society with established rules and orders, excludability of a resource is decided and secured by agreed-upon rules backed up by social sanctions, so that dissipation resulting from exclusion by individual violence can be avoided.

The study of Umbeck (1981) on California gold rush revealed the possibility of establishing rules and orders through private contracting. Moreover, many works on the problem of common pool resources, such as Libecap (1989), Ostrom (1990), and others, also focused on whether and how the involved interests acted collectively to establish the exclusive rights, via member-owned organizations, mediation, court rulings, or legislation. In some cases, legislation for securing the income right of service providers is sufficient. The study of Pool (1980) on fire control subscription business provided a good illustration. Patents and copyrights are also conspicuous examples.

Given the possibility of exclusion, the literature of excludable public goods has been developed, owing to Thompson (1968), Oakland (1974, 1987) among others.[2] It has raised the concerns about the efficiency problem in the cases of monopolists with or without information for necessary price discrimination. These considerations are important especially when limited market demands cause slim profit margins so that for-profit firms cannot survive without being able to conduct (near) perfect price discrimination. The analysis may apply to such businesses as museums, libraries, high-culture performing arts, higher education, and academic researches.

The development of club good theories since Buchanan (1965), Tiebout (1958), and Olson (1965), is among the most remarkable.[3] Recent extension on the issues of transaction costs (e.g., Helsley and Strange (1991)), combined with asymmetric information

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[2] For more reference, see Cornes and Sandler (1996, p. 248).

[3] See Sandler and Tschirhart (1980, 1997), and Cornes and Sandler (1996) for the detailed survey of club theories.

(e.g., Lee (1991)), raised the concern as to the role those factors play in the institutional selection. As Cornes and Sandler (1996) point out, it is now commonly concluded among club good theorists that preferable institutional choices depend on such factors as monopoly, transaction costs, asymmetric information, and so on. Further research is necessary on institutional patterns and their determination.

2.3. Concepts of Property Rights and Transaction Costs

2.3.1. Property rights and private property

Scarcity of resources makes competition inevitable. The conflict of competition must be resolved in some manner. Arman A. Alchian proposed that the establishment of property rights is to replace competition by destructive violence with competition by peaceful or orderly means; therefore, the rules that restrain competition for resources are known as property rights.[4] Conceivably if resources were always more than sufficient so that there was no need for competition, property right arrangement would be of no purpose.

Perhaps Cheung (1970, 1974) is the first economist who explicitly defined private property rights, which is now commonly accepted.[5] Three distinctive sets of rights are identified and associated with idealized private ownership. The first is the rights to use or decide how to use the resource, which may also be viewed as rights to exclude non-owners. The second is the rights to appropriate the stream of rents from use of and investments in the resource. The third is the rights to sell or otherwise transfer the resource to others.

In reality, private property is a matter of degree. Attenuation of a private property can result from relaxed exclusive rights to use, to receive income, to transfer, or any of their

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[4] See Alchian (1987, 1993, 1995), and Alchian and Allen (1964).
[5] See, for example, Alchian (1993, p. 69), De Alessi (1980, p. 4), Hansmann (1996, p. 11), and Libecap (1989, p. 1).

combination. Different situations may lead to different outcomes of corresponding contractual behavior, resource allocation, and income distribution. In order to investigate those issues, it is important to distinguish different sets of rights and examine the relationship among them.

Moreover, the absence or attenuation of exclusive rights may be attributed to prohibitively high costs of delineating and policing their limits. Similarly, the transfer of rights in the market is not only constrained by institutions but also by the costs of negotiating and enforcing contracts. In drawing inferences on changes in rights, for example, it is important not only to investigate whether there are observable institutional changes, but also whether there are changes in the costs of transacting. In economics literature, these costs are called "transaction costs."

2.3.2. Transaction costs

As most economists agree that the transaction costs include those of searching, negotiating and enforcing contracts, and so on, there seems to be no agreement on its definition. Two main views have arisen among economists.

The first defines transaction costs as "the costs of using the price mechanism" (Coase (1937)); that is, all costs associated with market transacting. In Coase's own analogy, they would be those costs that did not exist in a completely communist society, where a central governmental authority directed the use and allocation of all resources (Coase (1992, p. 73)). Examples include costs of discovering the prices, negotiating and closing a contract, enforcing a contract, and so on. Note that, in this view, transaction costs do not include agency costs, and costs of collective decision-making among owners within an enterprise, all of which are at times termed "governance costs."

This paper follows the second viewpoint, the broadest sense of "transaction costs" proposed by Cheung (1978) as "all those costs that cannot be conceived to exist in a Robinson Crusoe (one-man) economy." The term then includes not only the costs of contracting and negotiating, but also those of measuring and policing property rights, of engaging in politics for power, of monitoring performances, and of organizing activities. In other words, they are the costs of coordinating the activities of different people in the economic system. As Cheung often adds, a better phrase will be "institutional costs".

According to Cheung (1978), one important reason for the broader definition is that, as in the case of joint products, different types of transaction costs are often separable only at the margin. Sometimes it is difficult, if not impossible, to separate the cost of governance from the cost of exchange. For example, a manager hired to monitor other employees may also help to negotiate a contract.

However, in this dissertation I shall further argue that many inputs may contribute to the process of both production and exchange; hence, production costs and various sorts of transactions costs frequently cannot be separated. For example, a foreman may not only be involved directly in the production, but also monitor workers and provide the management with valuable information on workers' needs. Therefore, knowing the existence of transaction costs is more important than individually measuring them.[6] Nonetheless, testable propositions will still be feasible if we are able to at least rank the *total* costs of both production and exchange under different circumstances.

It is always helpful if we make the concept of transaction costs as concrete as possible. For example, to estimate the sum of agency costs in general, this dissertation

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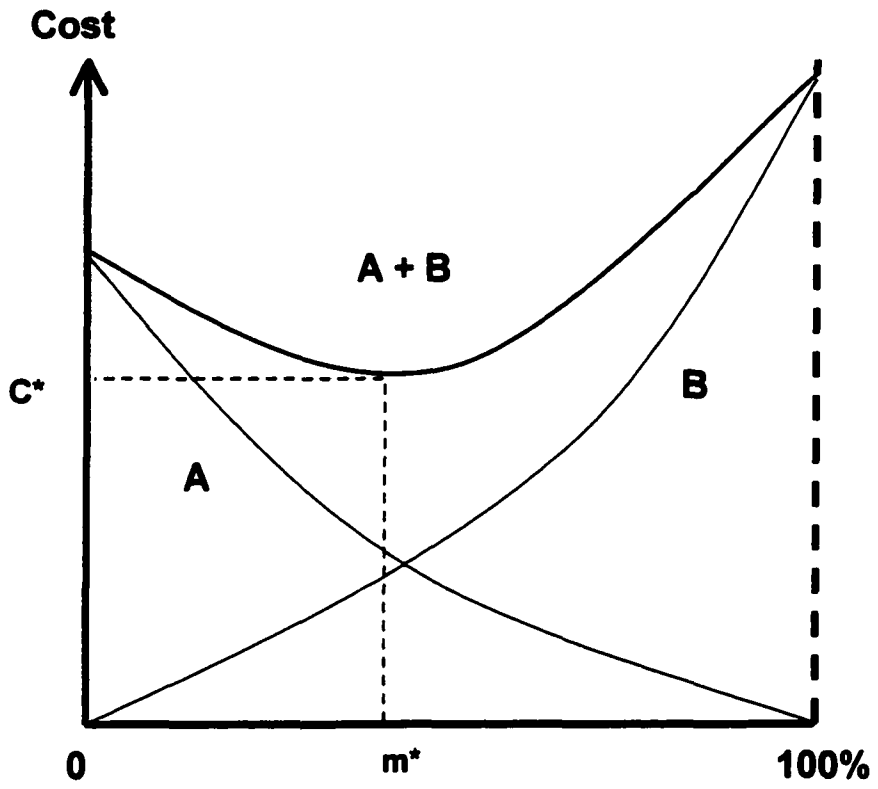
[6] Wallis and North (1986) attempted to directly measure transaction costs in the American economy over 100 years. However, the problem of inseparable costs of production and transaction was argued by some critics to be overwhelming against the robustness of their estimation. See Davis (1986).

proposes the following diagram. Figure 2.1 depicts an example of the cost elements constituting the "agency costs." The degree of effective monitoring is on the horizontal axis, and the cost level on the vertical axis. Note that the degree of monitoring is expressed in the percentage terms for the demonstrative purpose. Curve A represents the expected cost resulting from the agent's opportunistic behaviors, including shirking, self-dealing, and so on. As the degree of effective monitoring increases, this portion of cost is expected to decrease, and eventually become zero under the perfect monitoring. On the other hand, resources need to be devoted into raising the effectiveness of monitoring, the cost of which is illustrated by the curve B. Higher degree of monitoring generally results in higher level of cost, as shown by the upward sloping of curve B.

Under the postulate of cost minimization, the principle chooses the degree of monitoring that minimizes the total of expected loss from the agent's opportunism and monitoring cost. The level of the "agency costs", hence, is proposed here as the minimized sum of both cost elements. Consider the case that the agents are close family members so that the cost of the agents' opportunism is expected to be relatively low at each monitoring level, represented by a lower curve A than otherwise. The cost-minimizing level of monitoring will become lower since it is now less necessary to prevent the agents' opportunistic behaviors. As another example, suppose the cost of monitoring is largely reduced owing to the improved monitoring technique, represented by a lower curve B than otherwise. The optimal monitoring level will become higher since monitoring is now more worthwhile. In either example, the smaller total of the agency costs will result, despite of the changed degree of monitoring.



A: Cost of the agent's opportunism

B: Cost of monitoring

m*: Optimal degree of monitoring

C*: The level of total agency costs

Figure 2.1. Elements of agency cost

2.4. Costs of Collective Decision-Making

In this dissertation, the difficulties of collective decision-making by diverse interests will be placed into special emphasis. Owing to the literature of public choice, extensively surveyed by Mueller (1989), economists have better understood some of voting behaviors and associated problems. Median voter theorem maintains that under certain conditions the median voter is in the decisive position of voting outcome if majority rule is adopted. If the median voter is significantly different from the average representative of population, then the voting outcome may be undesirable (Bergstrom (1979)). These have led to the concerns about undesirable voting outcome due to insignificant majority.

On the other hand, well-organized minority might be able to control the voting outcome in favor of their interests. As formally analyzed in the paper of Denzau and Munger (1986), an organized minority may be able to affect the voting outcome by paying campaign contributions to some legislators who represent the unorganized voters with less conflicting interests or with informational disadvantages. In other words, there can be some cases in which unrepresentative but influential minority determines the voting outcome.

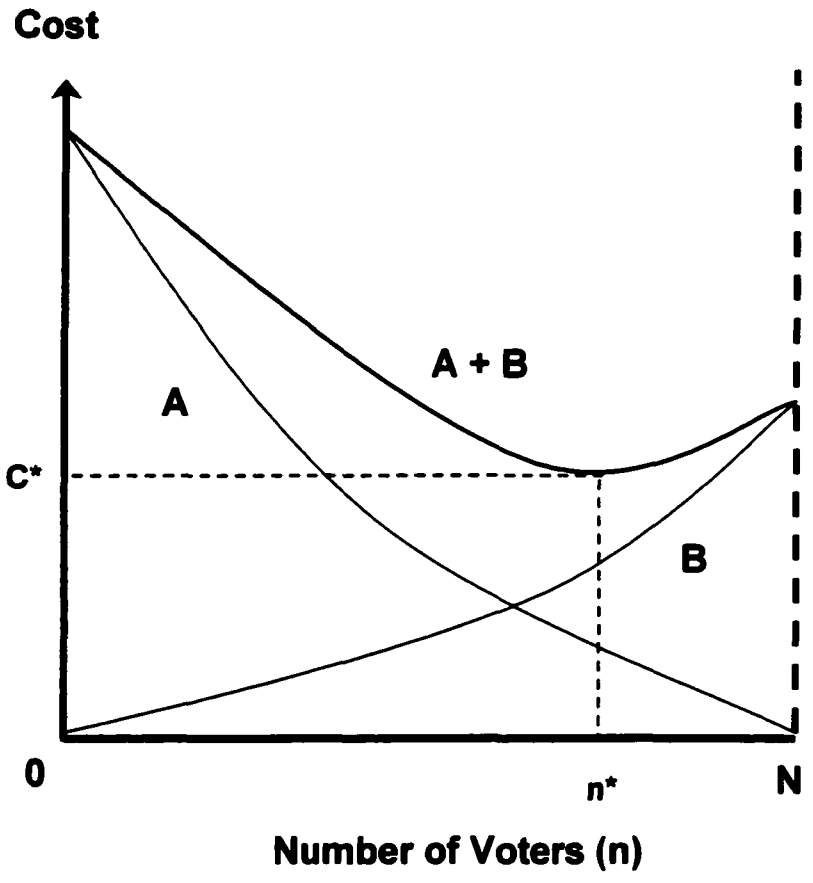
Although vote trading through coalition is one possible solution for the above problems, voting trading is also subjected to cost consideration. Moreover, voting trading is not free from another well-known difficulty, voting cycle. Voting cycle can cause such problems as unstable decision-making, and agenda control by influential individual or group.

However, institutional arrangements such as procedural restrictions on voting, and delegation in the committee system, may mitigate the problem of voting cycles, as maintained in the literature on structure-induced equilibrium (Shepsle (1979), Shepsle and Weingast (1987)). Research efforts have since been devoted to investigating the emergence of such political institutions. Commonly accepted theory does not exist so far.

Among the notable developments, recently surveyed by Shepsle and Weingast (1994), Weingast and Marshall (1988) for instance analyzed the formation of political organizations, applying the organizational theory of new institutional economics. Since the institutional and organizational choice of public good provision often involves legislation and other governmental regulations, some knowledge in the operation of political institutions is necessary.

To make more concrete the concept of costs of collective decision-making, in this dissertation, the costs of collective decision-making are represented in the following diagram. Figure 2.2 illustrates the cost elements constituting the cost of collective decision-making. For demonstration, the choice of decision rules is simplified as the choice of majority rules. Following Buchanan and Tullock (1962), the horizontal axis measures the percentage of voters required for making a collective decision, as the vertical axis shows the cost level. Curve A depicts the expected cost resulting from sacrificing those losing opposed in voting, given a certain decision rule. The cost of this kind is expected to decrease as the required percentage of agreeing voters increases. When the unanimity rule is adopted, the expected cost of sacrificing the opposing interests becomes zero. On the other hand, the higher the percentage of required votes for decision-making, the more costly it would generally take to form a decisive coalition, since more interests need to be addressed in exchange for their votes. This recognition is reflected in the upward-slopping curve B, the cost of forming a decisive coalition.

Given the postulate of cost minimization, the involved as a whole choose the percentage of votes required for decision-making, which minimizes the *total* of expected sacrifice of the opposing interests and cost of vote exchange. Hence, the cost level of collective decision-making is proposed as the sum of both cost elements.



A: Cost of sacrificing the opposed

B: Cost of forming winning coalition

n*: Optimal majority rule

N: Number of total voters

C*: Cost of collective decision-making

Figure 2.2. Cost of collective decision-making

2.5. Ownership Structure of Enterprise by Hansmann

For the purpose of production and exchange, resource owners are connected by a set of contracts within an organization.[7] On the supply side, there are owners of various factors of production, including investors of capital, managers, workers, and providers of other goods or services as inputs. On the demand side, customers pay prices in exchange for goods or services. These people are called "patrons" of an enterprise in the term of Hansmann (1996). There are in general two forms of connection between an organization and patrons. One is in the form of ownership, to which the organization is assigned. The other is in the form of market contracts between the organization and patrons, such as loan contracts, employment contracts, contracts of sale, and so on.

It is not difficult to see that different classes of patrons may have different cost advantages or disadvantages in (1) exercising their property rights associated with the collective ownership if they are the owners, and in (2) market contracting if not. For example, a class of patrons could be so diverse in terms of their interests, so dispersed in location, or so transient as patrons, that the costs related to collective decision making, monitoring employees, and so on, are prohibitively high. On the other hand, some class of patrons could suffer from enormously costly activities of market contracting, due to the price exploitation by the monopoly, the "lock-in" problem resulting from transaction specificity, or serious informational disadvantages. If less costly relations with an organization are chosen for all patrons, then higher organizational efficiency in terms of cost saving will result. This is the central idea in the ownership arrangement based on the postulate of transaction costs minimization.

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[7] See Jensen and Meckling (1976) for the view of "a firm as a nexus of contract."

2.5.1. Classification of organizations

In Hansmann's view, the traditional business corporation is arranged in the way that the ownership of enterprise is assigned to the investors of capital. When the ownership is assigned to managers and other workers, such an organizational form as partnership and worker cooperatives emerge. Some organizations such as farmer-owned producer cooperatives, dominating the markets for basic agricultural commodities, are conspicuous examples of the ownership assigned to the suppliers of raw materials as inputs. These are all classified as producer ownership of different forms in this dissertation.

On the other hand, when customers are arranged as the owners, there occur such organizations as consumer retail cooperatives, wholesale and supply cooperatives, associative associations, member-owned clubs, condominium and housing cooperatives. These are among the forms of customer ownership.

Another possibility is that the ownership is assigned to no one. Such an organization is called "nonprofit" by Hansmann (1996). Accordingly, a nonprofit organization may be managed by some people but no one owns a share of the organization as fee simple. Managers or board of directors/trustees are hired to run the business on a fiduciary basis. Profits or net earnings, if any, will be retained within the organization exclusively for financing the organization-related activities.

Note that Hansmann's definition of nonprofit is different from those of some other law scholars. In many states of the United States, related laws at present regard as nonprofit such organizations as housing cooperatives and condominium, member-owned clubs, trade associations, and so on (Oleck (1980, chapter 2)). Most of these are placed into the category of customer ownership instead in Hansmann's classification.

In my view, the disagreement probably results from the subtlety that the (stream of) benefits/rents generated from an asset take either the pecuniary or non-pecuniary form.

When the main purpose of a member-owned organization is to provide services for its members instead of profit generating, the organization may be financed by merely assessing member fees for necessary expenditures. No pecuniary earnings will be generated from providing services in this case. The organization is literally "not-for-profit." Naturally it leads to the impression and terminology of "nonprofit". Nonetheless, this dissertation does not intend to take part in the definitional dispute, which must involve subjective preference or values. Despite the definition for a "nonprofit" organization, disagreement shall disappear when we focus on the ownership arrangement.

In addition, when a certain class of patrons suffers from prohibitive costs of market contracting, such a class of patrons may then be the most appropriate owners even if they cannot effectively exercise their property rights. Since this sort of ownership attenuation is a matter of degree, the distinction between nominal ownership and absence of patron ownership will become blurred at the margin. Examples are many, including such organizations as publicly traded corporations, mutual insurance companies, mutual banking institutions, and so on. In those cases, while organizations are nominally owned by either their investors, customers or members, they are operated by a group of managers largely free of owner interference.

Extended from Hansmann's organizational classification, this dissertation maintains that the government can be regarded as a form of nominal customer ownership. Taxpayers, as the owners of a state, are essentially the customers of governmental services. While they can elect their representatives to control the government, such control is in many cases ineffective, rendering certain degree of administrative autonomy. Various forms of bureaucratic inefficiency and corruption present the very essence of agency costs. As mentioned above, the more attenuated the collective taxpayer ownership, the more blurred the distinction between the collective ownership and its absence. Besides, when budget

surplus occurs, it is usually retained within the government, similar to the "non-distribution constraint", to which nonprofit organizations are subject. Therefore, the government is similar in many ways to the form of nonprofit organizations, and may be called a member-controlled nonprofit organization.

For some times a few economists such as Coase and North have viewed the government within the framework of firm organization. More specifically, the government takes the form of nominal customer/member ownership. With this general viewpoint, all sorts of organizations can be placed into single unified framework of analysis, as we shall see more clearly later in chapter 4.

2.6. Competition among Interest Groups

Although institutional efficiency gains are presumably beneficial to the involved interests as a whole, distribution of the resulting benefits may be such a difficult undertaking that the institution with the highest perceived efficiency would not be reached. From one perspective, this merely reflects that distribution of benefits among diverse interests can be prohibitively costly. Logically, under the postulate of constrained maximization, if a scheme of compensatory side payment could be easily devised and enforced from the beneficiary to the harmed, the highest institutional efficiency would always be achieved.

In economic literature, studies on regulations have attempted to provide theories and their empirical evidences for the formation of regulatory institutions. Specific in the area of regulations, these theories carry broad implications that apply to the formation of institutional arrangements in general. Among the noted are "public interest theory," capture theory," and "economic theory of regulation." Competition among different interests for favorable

institutional arrangements has gradually become the central theme, in accord with that of the public choice literature.

Public interest theory, also called "normative analysis as a positive theory" since Joskow and Noll (1981), claimed that regulation should and would occur in industries plagued with market failures, such as natural monopoly, externality, and imperfect information. Moreover, this theory was later refined to argue that regulation could be mismanaged by the regulatory agency. On the other hand, the capture theory, long existing in the literature of political science,[8] maintained that either the legislature provides regulation in response to the industry's need, or the regulatory agency comes to be controlled by the industry over time. In addition to their empirical counter evidences, these two "theories" have been criticized as stated hypotheses with little theoretical underpinnings.

Equipped with the main thesis of Olson (1965), Chicago scholars Stigler (1971), Posner (1974), Pelzman (1976), and Becker (1983), have collectively established so-called "economic theory of regulation" (ET). According to ET, different interest groups compete for favorable regulation, and regulation tends to be beneficial to relatively small groups with strong preferences over regulation at the cost of relatively large groups with weak preferences. Also, ET argues that regulation is most likely in relatively competitive or relative monopolistic industries, since in these industries regulation will have the bigger impact on some interest' well-being. Recognized as an important theoretical development, ET has nevertheless been under severe criticism.

One important criticism is that ET grossly ignores how the legislative and regulatory institutions operate in practice. That is, it assumes unrealistically that interest groups adequately control legislators and regulatory agencies passively respond to the legislation.

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[8] See for example, Herring (1936), Huntington (1952), Bernstein (1955), Edelman (1964), and Lowi (1969).

Moreover, the claimed advantages of well-organized small groups over unorganized populous interests have been forcefully challenged.

To elaborate, first of all, industry interest fails frequently to present a united front. That is, the regulated industry often consists of different interests and hence different standpoints for regulation. For example, antitrust laws on mergers, price discrimination, and vertical restrictions such as exclusive dealing are generally supported by small businesses, while opposed by large enterprises. In the case of food safety regulation, a single position is rarely possible for such competing interests as National Meat Council, Iowa Beef Packers, Wilson's, and Swift. It is also observed that large firms are less likely to oppose such regulation than are small ones. In short, carefully identifying different interests within an industry is inevitable for the analysis of interest competition.

As revealed by Denzau and Munger (1986), unorganized interests such as consumers or citizens may still be well represented in the political process owing to their voting power. It is because politicians, in order to secure reelection, have to take into account the preferences of unorganized but populous voters. Well-organized small interest groups can only be more likely to succeed in obtaining the support of politicians representing constituents with less conflicting interests, or with informational disadvantages. As the unorganized interests have great at stake, the involved issues will usually be highly salient. Dominance of well-organized small interests is far from easy when the issues are high in public salience.

Despite the notable hypothesis of bureaucratic budget-maximizing behaviors by Niskanen (1971), ET has simply assumed non-elected bureaucratic officials as (more or less) passive respondents to the desires of politicians. ET's assumption later found justification in the studies of Weingast and Moran (1983), McCubbins, Noll, and Weingast (1987, 1989), who argued that bureaucrats might be effectively constrained by the

legislators through budget appropriations, monitoring of oversight committees, and tight administrative rules.

However, this view has raised strong disagreement, especially from the scholars of public administration.[9] It is commonly shared among political scientists that, as regulatory activities gradually involves high degree of technical complexity, professionalism has established in many areas such as environmental, health and safety regulations. These professional bureaucrats are at times able to pursuit their own goals, following principles of scientific management, and discipline solidarity. Environmental Protection Agency against Ann Burford as the agency head in the Reagan administration may be the most famous example.

As emphasized by Johnson and Libecap (1994), bureaucracy should not be treated as single unitary entity as in the literature,[10] if we hope for advancing our knowledge about the bureaucratic behaviors. Their study identifies bureaucrats as three classes: political appointees, senior career officials, and rank-and-file career employees. Each class has distinctive constraints and incentives. First of all, the interests of political appointees are more aligned with those of their appointing politicians (e.g., elected chief executives). On the other hand, their interests may considerably differ from those of other politicians (e.g., legislators) representing distinctive constituents.

In contrast, senior career officials and rank-and-file career employees are frequently protected by job tenure and standardized payment plan, and thus owe no specific allegiance to the administrative or legislative politicians. Moreover, different policy positions among chief executives and legislators often render opportunities for bureaucratic discretion, especially when the control right to the bureaucracy is not well defined.

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[9] See, for example, Meier (1985, 1988), Moe (1993), and Wilson (1980, 1989).

[10] See, for example, Tullock (1965), Niskanen (1971), Weingast and Moran (1983), McCubbins, Noll, and Weingast (1987, 1989), Moe (1989).

As part of bureaucratic management, senior career officials have management directives to subordinates. With information advantage of agency operation, career bureaucrats are sometimes able to form strategic alliances with the administrative or legislative politicians in order to pursue own interests. The rise of bureaucratic professionalism may not only result in strong professional beliefs or preferences, but also job performance incentive through peer pressure and outside employment opportunities. For the issues involving high degree of technical complexity, the professional bureaucrats might be able to shape information and guide opinions. In short, career bureaucrats are not simply passive enforcers of policies made by politicians, as ET assumed.

Therefore, key actors in the institutional formation may include business groups, consumers/citizens, politicians, bureaucrats, and others,[11] depending on different situations. In general, the competitive advantages of different actors depend on their motivations, and capabilities or resources. Interests need enough motivation for taking actions, since involvement is often costly. However, even if strongly motivated, an actor may fail to exert meaningful influence due to lack of adequate capabilities or resources.

Gormley (1986) has proposed public salience and technical complexity as two important dimensions for judging which set of actors will be most likely to be influential in the competition for favorable institutions. By his definition, "a highly salient issue is one that affects a large number of people in a significant way. A highly complex issue is one that raises factual questions that cannot be answered by generalists or laypersons." (Gormley (1986, p. 598)) Examples of high public salience and low technical complexity include such issues as abortion, gun control, zoning regulation, and so on. Examples of high public salience and high technical complexity include such issues as occupational health and

[11] Others include judges, professional individuals or groups, journalists, and so on.

safety, new drug licensing, hazardous waste regulation, and so on. Examples of low public salience and low technical complexity include such issues as building inspections, restaurant inspections, election regulation, and so on. Finally, examples of low public salience but high technical complexity include occupational licensing, insurance regulation, securities regulation, and so on.

Consumer/citizen groups always play a part in the issues of high salience, since they have great pecuniary or non-pecuniary interests at stake. However, when the issues are also highly complex, their involvement becomes less effective. Similarly, politicians are always attracted to highly salient issues, due to high rewards from such investment. However, when the issues are also highly complex, their involvement often becomes less substantive or merely symbolic.

Business interests are the regular participants whether the issues are high in public salience or not. However, highly salient issues must involve intense competition with other interests, and thus making it difficult for business interests to secure institutional arrangements (entirely) in their favor. On the other hand, issues of high complexity make business interests more effective due to their professional expertise. Therefore, the testable hypothesis can be proposed that business interests is most likely to dominate in the institutional competition when the issues are low in public salience and high in complexity.

Bureaucrats are another class of regular participants since they are in charge of institutional enforcement. Given the above analysis, it shall be clear now that professional bureaucratic officials frequently become influential when the issues are highly salient and complex so that citizens and politicians find effective involvement difficult, while business interests find it difficult to manipulate for self interests without raising any objection. Technical complexity requires expertise to address, and high public salience eliminates the chance for domination by business interests.

Finally, the role of lower-level bureaucrats should not be ignored when the issues are neither salient nor complex. Through routine operations and discretion of detailed application, rank-and-file career bureaucrats may be able to cause "policy drift" by misusing their authority in inspections, fines, and the like.

In conclusion, competition among diverse interests is a complex phenomenon. It is fundamental to make careful distinction among key actors. It is also important to investigate the advantages/disadvantages of different actors under different situations. Small and well-organized interests do not necessarily lead to dominance in competition. Since most institutional arrangements are determined in the political process and enforced by the bureaucracy, some detailed knowledge about the governmental operations is essential in the study of institutional formation or changes. In other words, analysis cannot further advance without unveiling every obscure facet of the government.

Based on the literature discussed in this chapter, the investigation in the organizational choice of public good provision proceeds as follows. First, some elaboration on the definition and identification of non-rivalry characteristic precedes the investigation of its social construction. Next, theoretical analysis on the institutional and organizational choice is presented in the following section. Many public good cases such as public utilities, infrastructures, and so on, will be discussed in the process of deriving general organizational principles for public good provision.

3. NON-RIVALRY AND ITS SOCIAL CONSTRUCTION

3.1. Definitional Discussion

Samuelson (1954, p. 387) proposed the concept of collective consumption, later called non-rivalry, as the characteristic such that "each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good." This brief wording on the concept may need some careful interpretation. The first consideration is about its time element.

In Samuelson's timeless model, as long as consumers agree to share a rivalrous good such as a pen or chair by sequential uses, this shared rivalrous good then features non-rivalry of Samuelson's public good, due to the same unit of shared good entering into every individual's utility function. Such a rivalrous but sequentially usable good presumably should be ruled out from Samuelson's concept of non-rivalry. Therefore, it may be a good idea to rephrase the concept with the emphasis on time element. Here non-rivalry is worded as the characteristic such that one person's consumption of a unit of the good does not at all detract the consumption opportunities still available to others *simultaneously* from the same unit. A good example can be a flood-control dam enjoyed by all residents in the nearby valley.

Another consideration is about the relevant unit to the consumption good in question. In many cases, there are more than one way of referring to the relevant unit of the consumed object, hence rendering it difficult to distinguish clearly non-rivalry from rivalry feature. For example, a highway as a traveled space is essentially rivalrous since any

occupied spot cannot be simultaneously occupied by any other vehicle or object.[12] When the traffic is low, the needed occupancy period of every spot on a highway by a car is so short that every spot become immediately available to other cars. While a highway could turn from a road into a big parking lot sometimes, the nature of spatial rivalry never changes. However, if we refer an entire highway as the relevant unit of consumption, then it is almost impossible for Denver's mass traffic jam on interstate 80 to block any car in Des Moines in the same way at the same time. When the entire highway is considered, non-rivalry feature appears, though not to its full degree.

In addition, consumption activities can be so complex that referring the relevant unit in question is only part of the difficulties in identifying whether they are non-rivalrous or not. In many cases, a consumption good, which may be composed of a set of goods and services, delivers consumption benefits of more than one kinds, some of which are rivalrous, while others not. This point has long been recognized and emphasized in the literature of joint-product models,[13] based on the characteristic approach, attributable to those works by Lancaster (e.g. 1971), Gorman (1980), among others. For example, the Yellowstone National Park may deliver recreational, commercial, educational, and environmental benefits, which may or may not be rivalrous. Here it is no longer simple to identify whether a consumption good/service presents non-rivalry feature or otherwise.

3.2. Social Construction of Non-Rivalry

Partly in response to Malkin and Wildavsky (1991), Cornes and Sandler (1994a) clarified some misinterpretations and misuses of the concept of public good, while

[12] More precisely, the nature of spatial rivalry comes from the fact that any substance with three-dimensional periodic atomic arrangement has mass and occupies space.
[13] See, for example, Sandmo (1973), Sandler (1977, 1992), Cornes and Sandler (1984, 1994b).

maintaining the importance of studying these properties of the public good for evaluating resource allocations under different incentive structures. Their discussion also raised the interesting issue about endogeneity of the public good's properties. This section seeks to further address this topic.

We shall begin the discussion by asking the following question: why do people choose to create the public good shared among them when they can choose otherwise? Take again a group trip for example. The group members can choose either to drive their own vehicles, or to share a rental tour bus together. Under the consideration of various kinds of costs and benefits, if the choice of renting a tour bus results in higher net benefits, then the public good may be chosen by the group for the purpose of transportation. When a shared good/service such as car pooling is chosen, the property of (partial) non-rivalry, or a (congestible) public good, is then created. In addition, the degree of non-rivalry or congestibility depends on both the number of users and the chosen quantity or capacity of the shared good. In this sense, the non-rivalry or congestibility is said to be the result of choice, not inherent physical nature.

3.2.1. The possibility and benefit of cooperation

Although the inherent non-rivalry characteristic, if any, of a good implies the sharing possibility, but non-rivalry is not the necessary condition for sharing. A durable *or* renewable good with the potential of repeated uses can be shared among the public as long as both the following two circumstances prevail. (1) *Each individual use has to last for a relatively short period of time, or regeneration makes the same kind of good continually available.* (2) *The maintenance of the good does not interrupt the consumption activities in a significant way, or consumption behaviors can be regulated by a set of rules without much affecting the consumption activities.* Absence of any of the two will render significant difficulty in sharing.

Goods with the above two features can thus be chosen for the public use so that huge amount of resources will be released for other purposes, leading to more economical uses of scarce resources. Therefore, the possibility and benefit of sharing provide the motivation of creating the public nature of the shared good, regardless of its inherent physical nature of rivalry.

This proposition also supports the works on sharing rules of Cornes and Sandler (1994a, pp. 377-80), in which they argue that the incentive structure of the public good emerges as a natural implication of a sharing rule even when there is no technologically given public good.

Note that sharing is but one form of cooperation. Broadly speaking, any cooperative arrangement can be viewed as public since the outcome of cooperation affects all involved parties. For example, as revealed by Alchian, the establishment of property rights is to displace competition by destructive violence with competition by peaceful or orderly means. Reduced dissipation of scare resources is generally beneficial to all members in society. Moreover, consider the tremendous benefits due to the enormous increase of productivity brought about by specialization and division of labor. Such practice cannot take place without the necessary institutional and organizational arrangements facilitating transactions or distributions among people. From this perspective, all institutions and organizations bear public nature. Perhaps institutions and organizations serve as the most telling example of "endogenous" public nature.

Investigating the characteristic of public goods under the choice-theoretic framework, as I shall argue, significantly improves the economic analysis on the problem of public good provision. On one hand, involved interests decide whether and what kind of public goods should be provided. On the other, the provision also involves the institutional and

organizational choices for the purpose of production and exchange. Taking both into account, the predictive ability of economic analysis will increase.

Consider for example the problem of ozone depletion, which causes concerns about the possible harmful effects to human beings of solar ultraviolet radiation. To resolve this problem, several approaches are conceivable. One direction is to prevent further depletion of the ozone layer. This can be done, for example, by banning the use of CFCs (ozone-depleting chemicals) and seek substitute inputs for industrial purposes. Another direction is to eliminate or mitigate the danger of solar ultraviolet radiation. One option is to put certain substances in orbit/stratosphere for reflecting some portion of incoming sunlight, or reducing the solar ultraviolet radiation.[14] Another alternative may be to develop some medication for human resistance to the harmful effects of ultraviolet radiation.[15]

The first two approaches, ban of CFCs use and the "geo-engineering" method, involve public goods of different kinds, which may diverge significantly in terms of the required extent of international cooperation. On the other hand, the medical approach may involve only private goods/services (e.g., personal medicines or other medical treatments), and not rely on any form of international coordination. Hence, in theory, the direct incentive structure of the public good is not inevitable for solving the problem of ozone depletion.

More specifically, global banning of CFCs may differ from the geo-engineering approach in terms of institutional and organizational difficulties.[16] For example, the success in banning or largely reducing the emissions of CFCs depend not only on the attitudes of such industrialized countries as the United States, European Union, but also on other rapidly developing and populous countries such as China. If any significant party refuses to

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[14] Similar technical possibility has been discussed by Schelling (1992) in the problem of global warming.

[15] While the following discussion will be confined to those three approaches, it shall not be difficult to see that they do not exhaust all the possibilities.

[16] For some in-depth discussion, see, for example, Sandler (1997, chapter 4 and 5).

cooperate, due to the consideration of economic values generated from the industrial use of such chemicals, the result of this approach will hardly be optimistic. In contrast, the geo-engineering solution might be conducted alone by some country with the required technology, involving perhaps no more complicated issue than cost sharing among nations. However, the resources required in research and development can be tremendous before such technology ever matures.

Besides, compared with the geo-engineering technology, research and development on the medical innovation might not be a promising investment if the medication, once available and adopted, would use up much more of global resources for the continual provision of such medication for the world population over time. In this circumstance, the research efforts on developing the geo-engineering technology may be expected as more worthwhile and thus strongly encouraged.

In principle, under a comprehensive choice-theoretic framework, we can analyze and predict not only under what circumstances and in what kinds would a public good and the required technology be preferred, but also under what institutional and organizational arrangements would the public good be provided. While the above discussion has addressed the former to some extent, the latter is the center of the following chapter.

4. INSTITUTIONAL AND ORGANIZATIONAL CHOICE

4.1. A Comprehensive Classification of Organizations

To start the discussion, we shall review the organizational classification extended from the work of Hansmann (1996). Based on the ownership types, this dissertation insists that the classification be comprehensive. That is, institutions and organizations of all sorts can be included. This classification is presented in the following table.

Table 4.1 classifies all institutions and organizations by the ownership types. There are three columns in the table: the first is for ownership type, the second for owner identification, and the third for some representative examples. As shown in the first column, three primary ownership arrangements are identified, including producer ownership, customer ownership, and absence of patron ownership. In the category of producer ownership, suppliers of various kinds of production factors, in principle, can be arranged as the organization owners. Investors of capital, for example, are the most common class of owners, as seen in the case of traditional business corporations. Nonetheless, collective ownership held by other supplier groups has still been observed in practice. Examples include the partnership form of such professional services as law and accounting, driver-owned taxicab companies, worker-owned plywood cooperatives, and so on.

The second category of ownership structure is customer ownership. In some cases, customer group as a whole exercises effectively the control rights. Examples are many, including farm supply cooperatives, wholesale and supply cooperatives, stock exchanges, rural electricity/telephone cooperatives, condominiums, country clubs, and so on. In some examples, such as farm supply cooperatives and rural utility cooperatives, members' patronage is usually closely measured so as to maintain a system of control rights

Table 4.1. Classification of organizations by ownership arrangement

Ownership Types	Owners	Examples
Producer ownership	Investors of capital	Traditional business corporations
	Suppliers of other factors	Partnership (e.g., law, accounting, advertising) Various kinds of producer cooperatives (e.g., Driver-owned taxicab companies Worker-owned plywood cooperatives Employee-owned refuse collection companies) Farm marketing cooperatives
Customer ownership	Customers (effective control)	Cooperatives of farm supplies (e.g., fertilizer) Consumer retail cooperatives Wholesale and supply cooperatives Business-owned customer cooperatives (e.g., Associated Press, MasterCard, Visa Stock exchanges) Rural utility cooperatives Residential association and condominium Country clubs/social clubs
	Customers (attenuated control/ nominal)	Mutual insurance companies Mutual banking institutions Member-controlled nonprofit organizations (e.g., Public Broadcasting Service (PBS) Some scientific and educational societies Political parties) Governments
Absence of patron ownership	None	Religious organizations Some charitable organizations (e.g., Oxfam, CARE, American Red Cross) Some philanthropic foundations Some high-culture art-performing groups Some museums Some hospitals Some health maintenance organizations Some colleges and universities

proportional to their patronage. In others, such as condominiums, country clubs, one-member-one-vote is commonly applied in the process of collective decision-making. In general, the owners of these organizations can exercise their property rights effectively.

On the other hand, not all cases of collective customer ownership can be effectively enforced. For example, in the case of mutual insurance companies, and mutual banking institutions, members maintain only the right to net earnings, while the control rights are largely attenuated. As another example, some member-controlled nonprofits, such as Public Broadcasting Service (PBS), allow their members to elect only a fraction of board of directors. Significant attenuation of ownership also includes such cases as political parties, and governments.

The entire absence of patron ownership can be regarded as the maximal attenuation of property rights. No class of patrons is arranged as owners. Such organizations are controlled and managed by the independent management or board of directors/trustees on the fiduciary basis. Examples includes religious organizations, some charitable organizations, some hospitals, museums, colleges, and so on.

Two points about the above classification need some clarification. First, when an organization is collectively owned by businesses, distinction between customer and producer ownership may be arbitrary. For example, in the case of farm marketing cooperatives, farms can be viewed either as suppliers of agricultural products to the marketing firms, or as customers of marketing services. Therefore, many business-owned organizations may be labeled either as customer or producer ownership. This ambiguity, however, does not hinder our investigation; what is relevant is the reasons why certain class of patrons are arranged as owners.

Secondly, as previously mentioned, property rights associated with ownership are a matter of degree. In this dissertation, organizations under the effective ownership held by

some class of patrons will be termed "patron-owned" organizations. "Patron-controlled" will be reserved for significantly attenuated ownership.

In this chapter, the analysis focuses on the organizational patterns of production and exchange for various types of public goods. The discussion is organized as follows. In the case where use exclusion is relatively easy, the investigation is divided into four parts: (1) smooth market transacting; (2) transaction difficulty resulting from investment specificity and monopolistic power; (3) transaction difficulty resulting from asymmetric information; (4) change in difficulties of market transacting and collective ownership.

In the non-excludability case, three observed resolutions are discussed, including indirect transaction through a third transaction party, establishment of use exclusion, and establishment of protection for providers' income rights. Finally a summary table is provided at the end.

4.2. Use-Excludable

4.2.1. Cases of smooth market transacting

In the case of relatively easy use-exclusion, profitability attracts for-profit firms to compete for providing the public good in question. Production and exchange efficiencies resulting from the profit-maximizing incentive clearly advantage for-profit firms, especially investor-owned firms, to dominate markets when there are no concerns about such market transacting problems as monopolistic power, investment specificity, asymmetric information, and so on. One primary factor for the success of investor ownership lies in the high homogeneity of investors' interest – maximizing the return to their investment (Hansmann (1996, chapter 4)). Examples for its dominance are many, including popular recreations

(e.g. Disney), popular performing arts (e.g. Broadway), professional sports (e.g. NBA), and less noticed, law enforcement industry.

Perhaps contrary to general impression, law enforcement is possible and actually supplied by for-profit firms in many cases. Here law enforcement refers to police, corrections and jails, as well as judicial services. For example, it is common that private security firms contract for providing security services with many private parties such as individual households, residential associations, corporations, hospitals, colleges, banks, manufacturing plants, hotels, and retail stores. Moreover, these firms also contract with many local governments for providing partial or complete police services to parks, recreation areas, public housing projects, airports, nuclear test sites, city halls, courts, and so on.[17] Some studies show that, compared with governmental agency, contracted for-profit firms may have significant advantages in terms of cost saving and quality.[18] The same applies to the correction facilities and jails.[19] The differences may well indicate the disparity in the production and transaction costs under these two different organizational arrangements.

In the judicial area, where the long pre-trial delays (greatest in civil litigation) are infamous in the public court system, organizational arrangements other than governmental provision are also common. For example, arbitration and mediation are typically used in commercial and consumer disputes, medical malpractice, labor-management relations, neighborhoods and family strife, and environmental clashes. Also, it is observed that for-profit firms have entered the justice market of "rent-a-judge" since early 1980s, now in virtually every state in the United States. For example, as of March 1987, the private company Judicate employed 308 judges in 45 states and has been called the "national

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[17] See Benson (1990, pp. 180-182).
[18] Ibid., pp. 184-192.
[19] Ibid., pp. 182-184.

private court," offering quick and inexpensive dispute resolution.[20] These facts should not be surprising. As evident in the histories of customary law and the law merchant, many laws could be and were privately created and enforced.

Besides the organizational form of for-profit firms, voluntary group action against crime has been observed in certain occasions. Some community associations have devoted to providing their members with a variety of programs, including youth recreation or employment, neighborhood improvement, property engraving protection, escort services and self-defense training, and surveillance patrols. While such demands may be too infrequent and/or limited to attract for-profit firms, governmental provision may not be politically viable, or suffer from inappropriate scale and inflexibility to changes of demands. Member-owned organizations in some cases have proved possible, owing to such favorable factors as small scale, members' geographical proximity, members' large stakes, and so on. These factors help check within a bearable range the costs associated with the collective member ownership. The well-documented private streets in St. Louis and University City in Missouri are among the conspicuous examples.

To sum up, profitability in many use-excludable cases fosters the organizational form of for-profit firms, which have the advantages of efficient production and exchange due to the profit-maximizing incentive. When demands are too limited to attract for-profit firms, they could be served by such an organizational form of member-owned organizations, as long as collective ownership held by heterogeneous members is not prohibitively costly. Compared with governmental provision, if viable, voluntary organizational arrangements may have relative advantages in terms of provision scale and flexibility in certain cases.

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[20] Ibid., pp. 223-224.

4.2.2. Some difficulties of producer ownership in market transacting

When concerns prevail about monopolistic power, investment specificity, asymmetric information, and so on, provision under the unrestricted producer ownership is often problematic. Instead, there may emerge such institutional and organizational arrangements as regulated producer-owned firms, customer-owned organizations including governments at various levels, or nonprofit organizations. Among these alternatives, government involvement takes more than one form, including regulations on producer-owned firms, government aids, and direct government ownership. With the presence of market-transacting difficulties, it is the established regulations, and sometimes government aids, that contribute to the viability of producer ownership.

4.2.2.1. Investment specificity and monopolistic power

4.2.2.1.1. Electric utilities as the polar case. We shall start our discussion with the example of electric utilities. Although electricity itself is not a public good, the common presence of legal monopolistic status with regulations or government ownership inevitably brings in public elements to the provision of electric utility. More importantly, electric utilities provide perhaps the most revealing demonstration, owing to the clear organizational patterns. In the process of deriving general principles on organizational arrangements, other public utilities will also be discussed. Finally, with these organizational principles, analysis will extend to cover another set of examples, infrastructures, including roads, streets, highways, sewer systems, ports, airports, and the like.

It is long recognized that electric utilities suffer from such market transacting problems as monopolistic power, and investment-specificity.[21] In short, provision of electric

[21] See, for example, the works on "relational contracting" of Goldberg (1976), and Williamson (1976).

utilities requires enormous investments of durable specific assets, such as the local distribution network, which will lose its value if the transaction fails to continue after the network is built. The utility company needs safeguard for such investments. With scale economy characterizing the industry of electric utility, it seems inevitable that the delegated authority (e.g. the government) will grant the firm long-term exclusive right to serve. However, the local customers as a whole then become vulnerable and need safeguard against monopolistic exploitation as well. Hence, delimiting the bilateral protection, some form of regulation, either municipal franchise contracting (prior to early twentieth century) or state commission regulation, is arguably necessary and has been observed over time in the United States (e.g., Priest (1993)).

However, the mere presence of both investment specificity and monopolistic power does not necessarily lead to the conventional rate regulations. In other words, the rate regulations are not the only solution. If an electric utility company can be owned by its customers, the exploitative incentives against either side will be largely eliminated, since under such an organization the interests of the firm and its customers are highly aligned. In the United States, there are approximately one thousand electric utility companies organized as consumer cooperatives, locating in forty-six states. Not surprisingly, twenty-eight states do not regulate the cooperatives' rates.[22]

Then the question is, why are not all companies of electric utility organized as consumer cooperatives, if the organizational form of electric cooperatives can avoid the transacting difficulties resulting from monopolistic power and investment specificity? The answer lies primarily on the difficulties associated with collective ownership held by heterogeneous classes of customers. Supporting evidence can be found in the fact that

[22] Among the eighteen states with rate regulation on the cooperatives, ten employ a streamlined procedure. See Hansmann (1996, p. 170).

electricity cooperatives are located almost exclusively in rural areas.[23] In rural areas, farm and non-farm residential households form a dominant group of members with relatively homogeneous interests. On the other hand, due to large electricity demands, commercial and industrial users are highly welcome as members, with substantial bargaining power in establishing rates.[24] Such member composition and balance in power render relatively little unsolvable conflict of interests, facilitating the collective decision-making and control under customer ownership.

Further evidence is provided by the fact that investor-owned firms with rate regulation dominate such public utilities as water, gas, and mass transit, which are generally provided in metropolitan areas.[25] Conspicuously, the customers in metropolitan areas are so numerous, transient, and diverse in interests. The conflict of interests within such a consumer cooperative could be intense in making most decisions, such as on whether to make further investments, what to invest, and how to set rates or appropriate net earnings among residential, commercial, and industrial customers. Moreover, it will be prohibitively costly to maintain capital accounts for diverse and transient urban population. Customer ownership in the form of consumer cooperatives is conceivably an inefficient organizational arrangement in urban areas. This view helps explain in part, despite of those frequently criticized flaws associated with rate regulations, why most electricity is still supplied by regulated investor-owned firms in the United States.

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[23] According to Hansmann (1996, p. 173, and pp. 338-339), there is no discussion among economists on this phenomenon until 1989 by Dan Alger, Frederick Warren-Boulton, and others.
[24] Commercial and industrial users combined account only for 10 percent of the membership, but their electricity demand 40 percent of the total in rural electric cooperatives. Ibid., p. 170.
[25] Due to higher capital intensity and smaller customer base, these public utilities are rarely provided in rural areas. Rural households commonly get their water from wells, gas in tanks and bottles, and own vehicles for transportation.

Another organizational arrangement, municipally owned electric utilities, about fifteen hundred in the United States, are generally located in small towns.[26] Different from most other municipal services, the finances of a municipal utility are usually separated from those of the city. One significant advantage of municipal ownership over utility cooperatives is the sizable saving of costs incurring in maintaining capital accounts for diverse and transient municipal population.

As one form of customer ownership, the diversity and transience of municipal customers might have been expected to result in considerable conflict of interests, as previously discussed. However, while the class of residential customers is the dominant voter group, the commercial and industrial customers are rather influential in local politics due to their bargaining advantages. First, raising their electricity rates are likely to be reflected in higher prices for locally procured goods and services. Besides, it is often a credible threat by commercial and industrial customers to exit the municipality, or to seek electricity source outside the community. Such balance among different interests, as seen in rural utility cooperatives, is easier to achieve in small communities than in large ones.

The potential of pathologies resulting from contentious politics in large cities was actually recognized by commercial and industrial utility users, as well as utility companies. It is this coalition that lobbied in the early twentieth century for displacing municipal regulation by state commission regulation,[27] which are rather far away from local political wrestling.

Compared with the above two organizational forms (e.g., producer ownership and customer ownership), municipal ownership suffers from the disadvantage of adjusting to technological change, which has since 1920s increased the efficient scale of electricity

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[26] In a 1986 survey, 80 percent of the responding 496 municipal utilities served fewer than 15,000 customers. See American Public Power Association (1987).

[27] Many businessmen, under the auspices of the National Civic Federation, supported the change of regulatory regime. See Schap (1986, p. 22), or Anderson (1981, pp. 44-48).

generation. One possible explanation for the disadvantage is that the heterogeneity of municipalities prevents the adjustment in production scale by mutual cooperation. In contrast, rural utility cooperatives have been able to adopt a federation structure, from local distribution cooperatives to regional electricity generating and transmission (G&T) cooperatives. The inability to cooperate among municipalities may be attributable to their heterogeneity in size and composition. A long-term tendency is observed by Schap (1986) that municipal ownership has been gradually displaced by regulated investor ownership.

To sum up, despite of the efficiency resulting from the clear goal of an investor-owned firm to maximize the return of its capital, concerns arise with the presence of such transaction difficulties as of investment specificity and monopolistic power. For-profit customer cooperatives can largely avoid not only the transaction difficulties, but also those flaws associated with the rate regulation. However, the costs of collective customer ownership determine whether this organizational form is viable. Municipal ownership, while solving the same problems, is less responsive to market and its changes. As any form of customer ownership, its success or viability also depends on the difficulties associated with the collective ownership held by heterogeneous interests. In the case where the collective customer ownership is significantly inefficient, regulated investor ownership may become a desirable organizational arrangement.

4.2.2.1.2. Infrastructure. The above conclusions in organizational choices may generally apply to the provision of roads, streets, highways, sewer systems, ports, airports, and the like. To elaborate, first, all these cases involve large amount of specific durable investment. For the provision of these public facilities, it is necessary for all users to act as a whole through delegated authority entering into exclusive contracts, since these facilities requires integrated and coordinated schemes. Decentralized market contracting and competition among individual users and firms are likely to lead to undesirable outcome.

Once the provider's monopolistic position is legally established on one side, users need to seek safeguard against monopolistic exploitation on the other.

User ownership in the form of for-profit consumer cooperatives is extremely difficult in these cases. First, these facilities are either provided in urban areas, or cover vast regions involving large and dispersed population of different jurisdictions. Diversity of user interests can be drastic. Moreover, these facilities strongly affect local interests other than those of providers and direct users. Take airports as an example. Directly involved are not only the interests of airport providers, airlines, airline patrons, businesses within an airport, but also those of residential and commercial neighbors of an airport. Collective ownership held by direct users, even if possible, does not address all interests strongly involved.

In contrast, while avoiding the prohibitive burden of maintaining individual capital accounts, government ownership allows the collective decision-making and control of some degree by all involved interests through political process. This is because under the system of private property a government is collectively owned by their taxpayers by construction. Compared with consumer/user cooperatives, government ownership evidently has relative advantages in the provision of infrastructures.

However, it is not immediately clear whether government ownership also has similar advantages over regulated investor ownership. The nonprofit nature of government ownership results in notorious agency costs of various sorts. When regulated investor ownership clearly dominates government ownership in the case of urban public utilities, it is interesting to observe the overwhelming dominance of government ownership in the case of infrastructures. Such an observation needs closer investigation.

Take airports as example. Except small airports for general aviation purpose, most airports for large air carriers are owned by local governments so far. Military concerns prevailed at the formative stage of modern air transportation in 1920s. It helps explain why

governments have been actively involved in this area. Airline industry started to grow after World War II, and has gained its importance in transportation among developed countries since the end of 1950s. So-called "privatization fever" since 1980s seems to have started the trend of organizational conversion into regulated investor ownership in the provision of aviation-related public facilities such as airports.

Several forms of contractual and organizational arrangements have been observed, including public incorporation of governmental subsidiaries, long-term lease contracts, joint ventures with private companies, certain forms of split ownership, and so on. The conversion of British Airports Authority (BAA) into a private company, BAA plc., in 1987 may be one of the best-known examples.[28] In the United States, several sizable airports, such as Rickenbacker field in Ohio, Morristown airport in New Jersey, and others, have been leased to investor-owned firms.[29] The Alliance Airport, opened in December 1989, was developed by the Perot Group and the City of Forth Worth. In this case, 418 out of total 3,400 acres of property is owned by the city for runway/taxiway use.[30] In New York, the J.F. Kennedy airport is a government-owned facility with its terminals owned and managed by private airlines (Doganis (1992, p. 13)).

In the case of roads and highways, in contrast, the protection of firms' exclusion and income rights to the toll facilities is relatively costly and highly vulnerable to unfavorable regulatory settings. For example, by the middle of the nineteenth century, most of early turnpike companies had gone bankrupt owing to such factors as restrictions on the location of toll gates, legally permitting routes bypassing toll gates, and excessive toll exemption, as argued by Klein (1990, pp. 789-795). The use of indirect charges such as "shadow tolls"

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[28] The seven airports owned by BAA accounted for about three-fourths of all passenger traffic in the United Kingdom. See Ashford and Moore (1992, p. 2).
[29] Ibid., pp. 88-89.
[30] Ibid., p. 91.

also relies on legislative and administrative supports from the government. Moreover, voiced by automobile and trucking associations, as well as some government agencies, opposition against private toll ways has been politically influential.

However, gradual change in the organizational choice has been observed since decades ago. As regulatory knowledge and tolling techniques grow, the provision of roads and highways become a less risky business. Aided by the advance of financial institutions, concerns have been gradually mitigated over problems of capital-raising and insurance against inflation, exchange-rate fluctuations, legal liability, or political instability. Political opposition is expected to continually decline as the problem of double charging is improved.[31] Regulated investor ownership becomes more viable over time. When appropriate regulations are available as the safeguard against the possible exploitation of investor-owned firms, the organizational efficiency due to the profit-seeking incentive can be maintained to significant degree.

So-called "Build-Operate-Transfer (BOT) approach" has been observed since 1970s and 1980s for private investment for the infrastructure development. The BOT, sometimes called BOOT (Build-Own-Operate-Transfer), involves usually a consortium of private companies to finance, design, build, operate, and maintain some form of revenue-producing infrastructure project for a specific period, typically 20 to 40 years. Such a project may be for constructing a power plant, airport, toll road, bridge, tunnel, or water treatment plant. The BOT approach has several variations, including Build-Lease-Transfer (BLT), Build-Transfer-Operate (BTO), Build-Operate-Renewal of concession (BOR), Build-Own-Operate (BOO), and others. The use of toll, toll rate and/or rate of return are commonly under regulations. By 1995, Arizona, California, Florida, Minnesota, South Carolina, Texas,

[31] A common complaint among toll payers is about the extensive taxes on vehicle ownership and usage, such as purchase tax, annual license fees, taxes on fuel, tires, and other vehicle parts.

Virginia, and Washington have enacted legislation to authorize private toll projects on the basis of either BOT or its variations.[32] Toll facilities are even more common in Europe, and some other regions.[33]

To conclude, with technological and regulatory progresses, regulated investor ownership has been competing with government ownership in the provision of infrastructures. Unlike such public utilities as electricity and telephone, the form of consumer cooperatives is not viable, due to its prohibitive costs incurring in operating the collective ownership. In order to solve the problems of investment specificity and monopolistic power, our analysis maintains that government involvement is necessary and takes the form of either direct ownership or regulations on investor-owned firms. Moreover, our analysis predicts that regulated investor ownership will become the dominant form for the provision of infrastructures in time, due to the organizational efficiency, though limited, associated with the investor ownership.

4.2.2.2. Asymmetric information

The presence of informational gap between transacting parties may affect the organizational arrangements of production and exchange in many cases. Take for example such traditional charities as American Red Cross. Donors in a sense purchase services delivered to third parties with which the donors have little or no contact. The result is a radical case of asymmetric information (Hansmann (1996, pp. 229-230)). If such a charity was provided by an investor-owned firm, credibility would be a frequent question. The evident absence of investor ownership in the business of traditional charities suggests the credibility difficulty resulting from asymmetric information could be prohibitive.

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[32] See Roth (1996, p.185), and Poole (1996, pp. 170-171).
[33] See Roth (1996, chapter 7), and Poole (1996, pp. 168-169)

Alternatively, if the firm were organized as a donor-owned organization, its incentive to exploit its informational advantage would be largely eliminated. However, in the case of traditional charities, donors are numerous, dispersed, and transient, and their contributions are typically in such small amounts. Any effort to maintaining the collective ownership by those contributors would cost more than it would be worth. This example demonstrates once more that the main challenge for customer ownership lies in the difficulties of collective ownership held among heterogeneous customers.

The nonprofit form with the fiduciary and independent management avoids the problems related to both transaction and ownership as mentioned above. The legal constraint of retaining net earnings, if any, within the nonprofit eliminates donors' concerns about the exploitative incentives of investor-owners. Also, the nonprofit form of this type saves all the costs associated with the collective donor ownership. Although such nonprofits generally suffer from capital immobility, which results from lack of equity financing and return-maximizing incentive (Hansmann (1996, pp. 238-241)), their prominent role in the provision of human services such traditional charities might suggest net gains be positive in organizational efficiency.

This argument may be supported and further refined by observing some member-controlled nonprofits (e.g., PBS) where members have the power to elect only a fraction of board of directors. Compared with traditional charity nonprofits, such nonprofits' members are expected to be less numerous, more geographically concentrated, more aligned in interests, and/or have great deal at stake with the organizations. In other words, the difficulties of maintaining collective ownership are relatively small in the case of member-controlled nonprofits. As in the previous discussion on voluntary group action against crime, some community organizations or voluntary professional associations are such an example.

Hence, it has been argued that the forms of nonprofit and member ownership clearly blurred into each other at the margins.[34]

What if those traditional charities are exclusively provided by the government agencies? Since vast taxpayers or voters might support different or even conflicting policies on these issues, any decision through political process might involve significant compromise and hardly be expected as satisfactory. Wide dissatisfaction of "forced riding", or more likely, paucity or absence of charity provision may be the common outcome.

In contrast, one advantage of the nonprofit form becomes clear: donation financing serves as a "voluntary price discrimination" through which higher demanders for a charity contribute more to the provision. The result has to be Pareto-efficient. Interestingly, data shows that people do make significant donations for charities (e.g., Rose-Ackerman (1996)).

Besides the problem of "purchase for the remote third party" characterizing traditional charities, other examples of informational difficulties are many. In the cases of private primary/secondary schools, and four-year private colleges, Hansmann (1996, pp. 232-233) proposed the argument of voluntary repayment or "implicit loan" system to explain why, in these cases, donations come almost entirely from their own alumni (previous customers). The main theme is that, since it is difficult for an individual to pledge human capital as security for an education loan, market supply of such loans will be inadequate. The nonprofit form solves this problem by charging tuition below cost, in return for an implicit commitment of future donations as "repayment." On the other hand, the marginal increment to the educational service by individual donations is difficult to measure. The nonprofit form hence also provides alumni a safeguard by avoiding the exploitative incentive under investor ownership. One testable implication of the above analysis is that, if government is to

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[34] See Hansmann (1996, chapter 13, 14) on the mutual form in the insurance and banking business for more detailed discussion.

provide a more generous system of grants and loans, for-profit institutions would compete more effectively with nonprofit institutions in education.

From the discussion of the above cases, three factors are argued as the possible reasons why nonprofit organizations have been frequently observed: (1) informational difficulty in deciding the marginal increment of services attributable to individual contribution, (2) the possibility of voluntary contribution, and (3) costs of collective customer/donor ownership. These three factors also help explain the significant presence of nonprofits in the provision of high-culture performing arts, museums, and libraries. Note that those services are characterized by the high ratio of fixed to marginal costs, reflecting the fact of limited demands. Limited demands suggest slim profitability, and hence the possible difficulty for a for-profit firm in survival. Limited demands also suggest that government financing by general tax revenue not necessarily be politically feasible.

In conclusion, when the presence of asymmetric information hinders the viability of investor ownership, the nonprofit form with fiduciary and independent management may emerge to mitigate the problem if the conditions for customer ownership are highly unfavorable. Government provision is also an alternative, but not always viable through political process. Examples include such services as high-culture performing arts characterized by the limited demands, and traditional charities, which deliver mostly private benefits to certain groups of people. If government regulations or aids can eliminate the difficulties caused by asymmetric information, as in the case of education loan programs, investor ownership may become feasible.

4.2.2.3. Change in the difficulties of transaction and ownership

According to the above analysis, change in the difficulties of either market transacting or collective customer ownership may lead to the change in organizational

arrangements. Such change may result from technological or legal advances. In the case of traditional charities, for example, fast-advancing technology of electronic information systems might eventually overcome the difficulties in communication and decision-making among numerous and dispersed donors. Donor ownership would then turn into a promising organizational form. Such implications derived from the above analysis are empirically testable.

Legal institutions, including various kinds of government regulations, may also change some transaction and/or ownership difficulties that constitute the major obstacles against certain organizational arrangements. Such legal development may result from the growth of human knowledge and evolution of values. For example, publicly traded corporations or nonprofits may have become more viable due to the reduction of agency costs, resulting from the advance of rigorous accounting standards, extensive mandated disclosure, prohibitions on insider trading, procedural rules facilitating litigation, and so on.

On the other hand, interest competition also molds legal institutions. As mentioned previously, coalition of many business interests succeeded in displacing municipal regulation with state commission regulation on public utilities in early twentieth century. Such development reduces the negative influence of customer diversity on the operation of investor-owned utilities. The viability of the organizational form of investor ownership is therefore enhanced.

4.3. Use Non-Excludable

When use exclusion for a good/service is difficult, the interests involved will attempt to solve the difficulty. Once use exclusion and/or exclusive income rights are established,

the above analysis applies in general. In this section, four possible resolutions are discussed as follows.

4.3.1. Tie-in transactions

When the direct transaction of a good/service is considerably costly, such a good/service may be tied with the less costly transaction of other related goods/services. This is a frequently observed business practice, applying generally to the cases where the use exclusion of a public good is difficult. Bradford and Hildebrandt (1977), and Sandmo (1973) have long recognized the importance of goods' complementarity in enhancing the tie-in transactions. Such contractual arrangements require little direct government intervention since the non-excludability difficulty is resolved by including the non-excludable good/service in the transaction of an excludable good/service.

For example, in a rental high-rise apartment building, it is considerably costly to directly charge the tenants each time when they are using the common elevator. Frequently, the price for the elevator service is included in the rents of apartments, with different charges depending on the floor of the apartments. Although those most frequent users might be able to free-ride under such a pricing arrangement, such an arrangement saves the sizable costs of exclusion. In other words, tying the service of the common facilities with the transaction of the apartments makes it possible to circumvent the exclusion problem.

As another example, building a small dam on a public creek may enhance or generate the recreational value of the creek. However, it is considerably costly, if not impossible, for the dam builder/owner to directly charge for the enhanced recreational function of the creek. To avoid the non-excludability difficulty, the dam owner might tie the service of the dam with the transaction of such recreational business as the rental and/or

sale of canoes, tour canoeing, fishing trips, and other related services. By ways of tie-in transaction, the non-excludability difficulty of the dam service can be resolved without the governmental involvement.

4.3.2. Indirect transactions via a third transaction party

When the direct transaction, say, between A and B is considerably costly, indirect transaction could be done if less costly through the transaction between A and C, when there is also some transaction between B and C. This is not an uncommon business practice, which applies generally to the cases where a public good involves in the transaction between A and B. Such contractual arrangements require little direct governmental intervention.

For example, different from the other visual and audio entertainment such as movie making, it is difficult for television/radio broadcasting companies to directly charge the widespread and transient audience for the programs they provide. However, this difficulty has been overcome for broadcasting companies by charging their paying customers — business purchasers of commercial broadcasting, which in turn pass their advertisement expenditures to the audience. The provision of television/radio programs is essentially compensated in an indirectly way. From another viewpoint, popular television/radio programs attract large audience, and thus generate the value of and revenue from sales of commercial broadcasting. A broadcasting company has to maintain the popularity of its programs in order to attract the buyers of its commercial broadcasting.

As another example, in a shopping mall, some highly well-known firms are generally the primary sources of attraction to customers for all businesses and stores within. These popular firms may also contribute to the increased land value for the landowners. In this sense, their reputation capitals are public goods for all other businesses and landowners.

The absence of direct charge for the service of their reputation capitals suggests strongly the enormous costs associated with direct measurement. In practice, nonetheless, indirect compensation is commonly observed in the contractual arrangements. Those firms with high reputations often pay low or no rents to landowners for the occupied space, while other firms pay high rents for doing their businesses in the shopping mall. As a public good, the service of reputation capitals is not free of charge.[35]

4.3.3. Establishment of use exclusion

As shown in the literature of common pool resources, where exclusion of resource use is originally absent, people involved might succeed in establishing the agreed-upon rules for resource use and cost sharing. In essence, the problem of common pool resources concerns the establishment and enforcement of property rights, which require a group agreement backed up by group sanctions of various kinds. Member-owned organizations, mediation, court rulings, and legislation have been observed in many cases. For example, well-documented cases for those member-owned organizations are numerous, including high mountain meadows and forests in some villages in Switzerland and Japan; and irrigation systems in some areas in Spain and Philippines (Ostrom (1990, chapter 3)). When the problems of common pool resources involve vast population and regions, resolutions by court rulings or legislation become more feasible.

The difficulty of collective ownership held by different interests is the main challenge to those organizational arrangements. The degree of difficulty is positively related to the number and heterogeneity of group members, and negatively to the size of the aggregate expected gains from the institutional establishment, as forcefully argued by Libecap (1989),

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[35] Although the example of shopping malls may have long been familiar among economists, formal empirical studies are recent. See Pashigian and Gould (1998).

and others. When the difficulty is too costly to overcome, a group agreement will fail to come in a timely manner, or even fail to come at all. Infamous deterioration in fisheries and crude oil production supports this view.

4.3.4. Establishment of income right to the service provided

In the case of profitable service provision with non-excludability difficulty, the main concern is about how to secure the exclusive income right of providers to the revenue-generating service. With the aid of government legislation of protecting provider's income right, the profit-seeking incentive can be preserved to induce efficiencies of production and exchange. For example, the subscription services of fire control exist in many states such as Arizona, Georgia, Oregon, Montana, Tennessee, and so on. State legislation permits a for-profit firm to charge non-subscribers for its services afterwards, and the firm usually adopts a pricing policy encouraging subscription. Studies by Pool (1980, pp. 62-78) and others also indicate the advantages of for-profit firms in terms of cost savings. Copyright, and patent are also classic examples. When legislation secures profitability, producer ownership usually demonstrates its superiority in terms of efficiency. In other words, the viability of producer ownership relies on the assistance of government legislation in these cases.

However, the legislative process is one of interest competition. Establishing such income rights might encounter intense interest conflicts, which result from tremendous heterogeneity of those involved. In the case of fire-fighting service, for-profit firms often fail in legislative battles due to severe objection from the existing interest of government employees in charge of such service. Likewise, protection of intellectual property rarely progresses smoothly in history.

In conclusion, with the opportunity of tie-in transaction, non-excludability and other transacting difficulties can be resolved. Examples, among others, include common facilities tied with the transaction of the apartments, and dam service tied with some related recreational business. When a common third transaction party is available, some transaction difficulties between both sides of transaction may be solved through the indirect transactions with the common third. Commercial broadcasting and shopping malls provide clear illustration. Private contracting in these cases works well without the assistance of direction government intervention.

In the case of establishing the rules for governing the common pool resources, the cost of collective decision-making by competing interests plays a pivotal role, as in the case of establishing providers' income rights. The higher the associated cost will be the more numerous and heterogeneous the involved interests are. As in any case involving collective decision-making, the success in establishing exclusive rights to the common pool resources rests on the homogeneity of the involved interests.

4.4. Summary

The main conclusions in this chapter can be summarized in the following table. Table 4.2 contains four columns, including ownership types, organizational forms, associated characteristics and examples. First of all, the previous three main categories, producer, customer, and absence of patron ownership, are essentially identical except for two modifications. The first is the inclusion of regulated producer ownership, which consists of two organizational elements: producer ownership and regulations by the government, which is a form of customer ownership. The other is the separation of government ownership from the general customer ownership, merely for the convenience of explication.

Table 4.2. Summary of organizational arrangement of public good provision

Ownership Types	Organizational Choice	Characteristics	Examples
Producer Ownership	Investor-owned firms Other producer-owned firms	Under smooth market transacting Profit-seeking incentives Efficiency advantage due to homogeneity of owner interests	Popular recreations Popular performing arts Law enforcement
Regulated Producer Ownership	Producer-owned firms under government regulations	Solving transacting difficulties Limited profit-seeking incentives Reliance on regulatory quality	Urban utilities Infrastructures
Customer Ownership	For-profit customer cooperatives	Solving transacting difficulties Profit-seeking incentives Reliance on aligned interests of customers	Rural electricity/telephone cooperatives
	Member-owned organizations	Solving transacting difficulties Benefit-maximizing incentives Reliance on aligned interests of members	Community associations for crime control, common property Condominium/housing cooperatives
	Member-controlled organizations	Solving transacting and ownership difficulties Attenuated benefit-maximizing incentives Reliance on aligned interests of members and voluntary contribution	Charities
Government Ownership	Governments Government-owned Enterprises	Solving transacting difficulties Lack of profit-seeking incentives Vulnerability to interest diversity	Legislative, administrative, and judicial bodies Municipal utilities Infrastructures
Absence of patron ownership	Donation-financing nonprofits	Solving transacting and ownership difficulties Lack of profit-seeking incentives Reliance on voluntary contribution	Charities High-culture broadcasting High-culture performing arts Museums

Moreover, the organizational forms, as previously discussed, are specified in the second column, and examples given in the fourth. For instance, investor-owned firms and lawyer-owned firms (partnership) have been discussed in the case of popular recreations, popular performing arts, and law enforcement.

Regulated producer-owned firms were investigated in the case of urban utilities, and infrastructures such as roads, and airports. For-profit customer cooperatives (e.g., rural electricity cooperatives), government-owned businesses (e.g., municipally owned electric companies, and infrastructures) were also analyzed in the case of electricity utilities.

Member-owned or member-controlled organizations have been discussed in the case of community associations for crime control, and common property governance, as well as some charities. In the problem of common pool resource, in addition, government's legislative, regulatory, and judiciary actions were also mentioned. Finally, nonprofits with pure donation-financing were the focus of discussion for charities, high-culture broadcasting and performing arts.

The third column summarizes the most important characteristics for various kinds of organizational arrangements mentioned above. For example, investor-owned firms perform well under the condition of smooth market transacting, with the evident advantages of organizational efficiency, owing to its highly homogeneous owner group, and its clear goal – maximizing the return to invested capital. It also implies that the limitation of this organizational form lies in the various kinds of transacting difficulties.

Regulated producer ownership may resolve certain transaction difficulties, and hence shows its possible advantage over unregulated producer ownership. However, regulations also limit firms' profit-maximizing incentive. Regulations can be inappropriate in the sense that the loss owing to attenuated profit-maximizing incentive exceeds the benefit of preventing potential harm of transacting difficulties. Appropriate regulations can take long

time to develop, along with the gradual evolution of knowledge and/or social values. Moreover, interest conflicts can hinder the emergence of ideal regulations. Hence, reliance on the quality of regulatory regimes constitutes the major disadvantage of such organizational form.

Customer ownership can largely mitigate most of market-transacting difficulties. However, compared with investors of capital, customers as the owner group are often relatively heterogeneous. The more diverse the customer group is the more costly the collective ownership will be. Although reducing the degree of control by diverse owners avoids such costs, it also weakens the maximizing incentives and the associated efficiency. As one of (attenuated) customer ownership, government ownership features the same advantages and disadvantages as mentioned above. Reliance on the aligned interests of customers is the major limitation of customer ownership.

Finally, cancellation of patron ownership resolves certain transacting difficulties while avoiding the costs associated with patron ownership. These resulting benefits have to be so enormous as to justify the sacrifice of profit or benefit maximizing incentives. Moreover, the possibility of voluntary contributions determines whether donation-financing nonprofits are viable.

5. A SIMPLE FORMAL MODEL

This static model is planned to cover the choice of three simple organizational forms: (1) producer-owned firms and the product market, (2) member-owned organizations, (3) donation-financing nonprofits. Besides, some other related issues will also be addressed in this chapter, such as organizational alternatives serving as the safeguard for transacting problems, and the role of organization-specific benefits in the organizational choice. While a static framework is chosen in this chapter, my modeling here shall be regarded as an initial attempt in a long-term process of building a dynamic model. Dynamic settings shall allow more room for characterizing such time-related issues as interest competition and path dependence in the problem of institutional and organizational evolution. Nonetheless, with this static model I will aim at elaborating some fundamental organizational determinants that are less likely to change over time.

The organization of this chapter is as follows: first, the product market and investor-owned firms will be analyzed, followed by the discussion of member-owned organizations. In section 5.3, the primary themes of organizational choice for public good provision will be briefly discussed. Then the elaboration of organizational alternatives checking transacting problems will precede the discussion of the issue of organization-specific benefits. Finally, donation-financing nonprofits for the provision of public goods will be addressed.

5.1. Basic Settings of the Product Market

To begin with, suppose there are H consumers who differ in preferences and endowments. Let i denote a consumer, and i = 1, 2, ..., H. It is also assumed that there are

only two kinds of consumption goods in this society. One is a private good, denoted as y, which is treated as the numeraire. The other, denoted as X, is a shared/public good with the following feature: once good X is provided, its capacity/quality available to all consumers is identical; however, a consumer i may choose its individual utilization level/extent of good X, denoted as χ^i. For example, while the capacity of a road is fixed to all users during some time period, the uses of the road by different users depend on their individual needs. In notation, $x^i = \chi^i \cdot X$, $\forall$ i, where x^i denotes individual consumption level/extent of good X. It is assumed that $0 \leq \chi^i \leq 1$, $\forall$ i. This common feature characterizes a large number of public goods, including roads, streets, bridges, highways, sewer systems, ports, airports, lighthouses, water-supply or flood-control dams, museums, libraries, national parks, high-culture radio broadcasting, and so on.

Assume a consumer's utility function is

$$u^i = u^i(y^i, x^i), \quad \forall \text{ i},$$

which follows the conventional assumptions on utility function; i.e., strict quasi-concavity and increasing with respect to its arguments y^i and x^i ($\leqslant \chi^i \cdot X$). Suppose consumers buy good y in the market from its producers. On the other hand, there are at least two different alternatives for the production and exchange of good X. One is that consumers pay for their use of good X to its producer(s) in the market. Consumers can also collectively choose to form a member-owned organization/club, which provides shared good X.

Under the first organizational arrangement of producing and exchanging good X, consumers pay a price for using good X provided by a firm. Note that even if the consumption benefit of good X is non-excludable, the firm's right to income generated from providing good X can still be protected and secured through legislation. The subscription of fire protection is one such example. Here p represents the true price of consuming good X

in the market. That is, p is composed not only of the monetary price paid, but also of such transacting costs as those of searching, bargaining, waiting, and so on. Let p_f denote the monetary price charged by a firm, and p^i_t denote the consumer i's transacting cost so the true price, denoted as $p^i = p_f + p^i_t$. Consequently, a consumer's resource constraint be

$$y^i + (p_f + p^i_t)\cdot\chi^i\cdot X = I^i, \quad \forall\, i,$$

where I^i denotes resource endowment for consumer i.

Incorporating the resource constraint in the consumer's utility function, consumer i solve the following maximizing problem:

$$\text{Max}_{\{\chi\}}\ v^i \equiv u^i(I^i - (p_f + p^i_t)\cdot\chi^i\cdot X,\ \chi^i\cdot X), \quad \forall\, i.$$

$$\text{s.t.} \quad 0 \le I^i - (p_f + p^i_t)\cdot\chi^i\cdot X,$$

$$0 \le \chi^i \le 1.$$

The solution $\chi^{i\bullet} = \chi^i(I^i, p_f, p^i_t, X)$, and indirect utility function is

$$v^{i\bullet} \equiv u^i(I^i - (p_f + p^i_t)\cdot\chi^{i\bullet}\cdot X,\ \chi^{i\bullet}\cdot X) = v^i(I^i, p_f, p^i_t, X), \qquad \forall\, i.$$

On the supply side of the market transaction, assume the cost function of the for-profit firm is

$$C^f(\alpha, \beta, \delta^f, \varepsilon^f),$$

where (1) α denotes the cost element of producing and maintaining good X, (2) β denotes the cost associated with use congestion, (3) δ^f denotes the total of various costs, bore by the investor-owned firm, incurring in the process of market transacting, and (4) ε^f is the cost of collective decision-making by the professional investors of capital.

In some details, as the standard cost function of production, let $\alpha = \alpha(X,\chi^T)$, where $\chi^T \equiv \sum^n_{i=1} \chi^i$, and assume that $\alpha_X, \alpha_\chi, \alpha_{XX}, \alpha_{\chi\chi} > 0$, where α_X, α_χ, α_{XX}, and $\alpha_{\chi\chi}$ denote the first and second degree of derivatives with respect to X and χ^T, respectively. $\alpha(X, \chi^T)$ is determined by current state of production technology. In general, the production cost is

positively related to the capacity/quality of good X, and the maintenance cost is also positively related to the aggregate utilization level/extent of customers.

Secondly, the congestion cost, β, is expected as positively related to the aggregate utilization level/extent of customers, and negatively to the capacity/quality of good X. In notation, $\beta = \beta(\chi^T, X)$, assuming $\beta_\chi \equiv \partial\beta/\partial\chi^T \geq 0$, $\beta_{\chi\chi} \equiv \partial^2\beta/(\partial\chi^T)^2 \geq 0$, $\beta_X \equiv \partial\beta/\partial X \leq 0$, $\beta_{XX} \equiv \partial^2\beta/(\partial X)^2 \leq 0$.

Thirdly, δ^f denotes various kinds of transacting costs under the organizational arrangement of the market of good X provided by the investor-owned firm(s). Not only does δ^f include such costs as of license application, bribery, and the like, but also costs resulting from various kinds of transacting difficulties, such as investment specificity, informational asymmetry, and so on. Hence, δ^f could be enormous in some cases, while negligible in others. Here, it is assumed that δ^f is related only to other exogenous factors than the capacity/quality of good X or the utilization levels of all customers.

Finally, ε^f, as the cost of ownership exercising by relatively homogeneous investors, is expected as relatively low, compared with such an arrangement as customer ownership. Hence, ε^f is argued as one primary cost advantage of the investor-owned firm. It is also assumed here that ε^f is unaffected by the provision level and customer utilization.

In summary for the above cost elements, the cost function for the investor-owned firm is denoted as

$$C^f(X, \chi^T) = C^f(\alpha(X, \chi^T), \beta(\chi^T, X), \delta^f, \varepsilon^f).$$

Note that it can be extremely difficult, if not impossible, to measure the cost elements α, β, δ^f, and ε^f individually. Much input may have the joint-product feature, contributing to in the process of both production and exchange. For example, a foreman may not only help directly the production, but also provide the management or owners with valuable

information on workers' needs. A lawyer may not only help negotiate a contract, deal with regulatory authority, but also give recommendations if asked by owners in the process of making decisions. Hence, production costs and various sorts of transactions costs frequently cannot be separated. However, knowing the existence of transaction costs enables us to estimate the total of all relevant costs under different organizational arrangements. The ability of at least ranking the total costs under different arrangements makes possible empirical study on organizational choices.

Therefore, the investor-owned firm solves X, p_f, and n for the profit-maximizing problem as follows:

$$\text{Max}_{\{X,\, p,\, n\}} \{\Sigma^n_{i=1}\, p_f \cdot \chi^i(p_f, X) \cdot X - C^f(\alpha(X, \chi^T), \beta(\chi^T, X), \delta^f, \varepsilon^f)\}$$

$$\text{s.t.} \qquad X,\, n,\, p_f \geq 0,$$

where $\chi^i(p_f, X)$ is the suppressed form of $\chi^i(l^i, p_f, p^i_t, X)$. The first-order conditions associated with X, n and p_f, respectively, are

$$\partial\Pi/\partial X \equiv \Sigma_i\, p_f \cdot (\chi^i + \chi^i_x \cdot X) - [C^f_\alpha \cdot (\alpha_X + \alpha_\chi \cdot \Sigma_i \chi^i_x) + C^f_\beta \cdot (\beta_X + \beta_\chi \cdot \Sigma_i \chi^i_x)] \leq 0,$$

$$X \geq 0, \qquad X \cdot \partial\Pi/\partial X = 0 \qquad (1),$$

$$\partial\Pi/\partial n \equiv p_f \cdot \chi^n \cdot X - [C^f_\alpha \cdot \alpha_\chi \cdot \chi^n + C^f_\beta \cdot \beta_\chi \cdot \chi^n] \leq 0,$$

$$n \geq 0, \qquad n \cdot \partial\Pi/\partial n = 0 \qquad (2),$$

and

$$\partial\Pi/\partial p_f \equiv \Sigma_i\, (\chi^i + p_f \chi^i_p) \cdot X - (C^f_\alpha \cdot \alpha_\chi + C^f_\beta \cdot \beta_\chi) \cdot (\Sigma_i \chi^i_p) \leq 0,$$

$$p_f \geq 0, \qquad p_f \cdot \partial\Pi/\partial p_f = 0 \qquad (3),$$

where $\chi^i_x \equiv \partial\chi^i/\partial X$, $\chi^i_p \equiv \partial\chi^i/\partial p_f$, $C^f_\alpha \equiv \partial C^f/\partial\alpha$, and $C^f_\beta \equiv \partial C^f/\partial\beta$.

To interpret, when non-negativity constraints are not binding, equation (1) requires that profit-maximizing capacity of good X should be chosen such that marginal revenue from the incremental capacity of good X equals the total of marginal costs resulting from

production, maintenance, and net congestion. Equation (2) shows that the profit-maximizing firm will choose the number of customers such that marginal revenue from serving an additional customer equals the total of marginal costs resulting from increased maintenance and congestion. Similarly, equation (3) means that the optimal pricing should be decided in such a way that marginal revenue equals the total of marginal costs associated with maintenance and congestion, owing to the price-induced change of customer utilization.

The profit-maximizing solutions for X, n, and p_f, denoted as X^*, n^*, and p_f^*, respectively, will be functions of I^i, p_t^i, δ^f, ε^f, and so on. Under the organizational arrangement of the market of good X provided by the investor-owned firm(s), the individual i's indirect utility function is then defined as

$$v^{i*} \equiv u^i(I^i - (p_f^* + p_t^i)\cdot\chi^{i*}\cdot X^*, \chi^{i*}\cdot X^*), \qquad \forall\ i,$$

where $\chi^{i*} \equiv \chi^i(I^i, p_f^*, p_t^i, X^*)$.

5.2. An Alternative: A Customer/Member-Owned Organization

Under the alternative arrangement, the consumers may form a member-owned organization for the provision of the shared good X. Assume the consumers agree to share all the costs associated with the organization; that is, the financing of full cost-sharing is pursued by the organization. Let θ^i denote the agreed-upon fraction shared by the consumer i of total costs, and hence

$$\theta^i \in [0, 1],\ \forall\ i, \text{ and } \textstyle\sum_i \theta^i = 1.$$

Note that, due to the assumption of full cost-sharing, the individual cost-sharing fractions can be denoted as the functions of the group size, n, and negatively related to n on average. That is, let $\theta^i = \theta^i(n)$, a function of the group size, and it follows that $\partial\underline{\theta}/\partial n = -1/(n^2) < 0$, where $\underline{\theta} \equiv \sum_i \theta^i/n = 1/n$.

Also, let $\oplus \equiv (\theta^1, \theta^2, \ldots, \theta^n)$, the vector of individual cost-sharing fractions under a specific cost sharing rule, $\forall \oplus \in \Theta$, where Θ denote the set of all possible rules for cost sharing. For example, in notation, $\theta^i = 1/n$, $\forall$ i, representing the equal-sharing rule. The sharing rule based on the ability to pay may be denoted as $\theta^i = I^i/(\sum_i I^i)$, $\forall$ i. When the principle of benefit proportionality is adopted, it may be expressed as $\theta^i = s^i/(\sum_i s^i)$, $\forall$ i, where s^i represents consumer i's total benefit/satisfaction given certain amount of good X. That is, let $p^i = p^i(x)$ be the inverse demand for good X of consumer i, and $s^i \equiv \int_q p^i(q)dq$, q $\in[0, X]$, $\forall$ i. Although in the above cases, individual share fraction θ^i is negatively related to the number of members, it is not generally true that $\partial\theta^i/\partial n < 0$. Conceivably, the agreed-upon sharing rule could require only the richest member pay for all costs. Then the individual share fractions for the rest do not vary as n increases.

Let all costs associated with the member-owned organization be denoted as

$$C(\alpha, \beta, \delta, \varepsilon, \oplus),$$

where (1) α denotes the cost element associated with producing and maintaining the good X, (2) β denotes the cost associated with use congestion, (3) δ denotes the transaction-related fixed costs, (4) ε denotes the cost associated with ownership exercising by diverse members, and (5) $\oplus$ denotes the adopted sharing rule.

Different from the above treatments regarding α, and β, in this section I shall follow one common treatment in the literature of club goods mainly for the contrast purpose. While the details of modeling are different, the fundamentals are essentially identical. First of all, as the standard cost function of production, let $\alpha = \alpha(X, n)$, and assume $\alpha_X, \alpha_n, \alpha_{XX}, \alpha_{nn} > 0$, where α_X, α_n, and α_{XX}, α_{nn} denote, respectively, the first and second degree of derivatives with respect to X and n. That is, the production cost is positively related to the capacity/quality of good X, and the maintenance cost is also positively related to the number

of members. Secondly, the congestion cost, β, is positively related to the number of members, and negatively to the quantity/capacity of good X. In notation, $\beta = \beta(n, X)$, assuming β_n, $\beta_{nn} \geq 0$, and β_x, $\beta_{xx} < 0$. Note that in some cases, such as flood-control dams, and high-culture broadcasting, there is no congestion cost, and thus $\beta = 0$. Once again, it is mainly for the purpose of comparison with the previous literature to assume α and β as functions of member size, instead of total utilization level of all members as in section 5.1.

The transaction-related fixed cost, δ, includes such costs as of lawyer payment, registration, license, or even bribery for favorable regulatory treatments, and the like. Note that many transacting difficulties such as investment specificity, informational asymmetry, and so on, do not result in cost disadvantages for consumer-owned organizations, since the interests of both transacting sides are highly aligned under such an arrangement. δ is assumed as unaffected by the amount of good X and the number of diverse members.

However, the cost of collective ownership held by diverse consumers, ε, frequently constitute the primary cost disadvantage for consumer-owned organization, especially in the context of public good problems. Customers could be so numerous, dispersed, transient, and diverse in interest that collective decision is difficult to make. Following Buchanan and Tullock (1962), the difficulty of collective decision-making is quantified as costs, which are measured as the sum of (1) expected loss from the sacrifice of the losing opposed and (2) resources involved in bargaining and negotiation for votes, under the cost-minimizing majority rule. The more diverse in interests, the higher the cost of collective decision-making is expected to be. Hence, it is assumed that $\varepsilon = \varepsilon(n)$, and ε', $\varepsilon'' > 0$.

Finally, different sharing rules $\oplus$'s generally incur different levels of enforcement costs. For example, the sharing rule based on benefit principle requires measurement on individual benefits, and corresponding pricing scheme. The rule of ability-to-pay also

demands information on members' wealth. On the other hand, equal sharing rule, if adopted, is relatively simple to enforce. Here the cost function is assumed to be discrete with respect to $\oplus$, for the reason that sharing rules are commonly different in kind in practice. To sum up, the cost function for the member-owned organization is denoted as

$$C(X, n, \oplus) = C(\alpha(X, n), \beta(n, X), \delta, \varepsilon(n), \oplus).$$

On the demand side, suppose consumers have their preferences and values on sharing rules. That is, the consumer i's utility function is assumed as, $\forall$ i,

$$u^i = u^i(y^i, X, \oplus), \qquad \oplus \in \Theta.$$

For example, the rule of equal sharing may not be preferable to those members who do not frequently use good X. The rule of ability-to-pay, likewise, might be distasteful to the less wealthy if invidious comparisons and resentments are generated. Here, individual utility is also assumed to be discrete with respect to the sharing rule $\oplus$ for the previous reason.

Accordingly, when the provision level of good X, the member size, and the sharing rule are decided within the member-owned organization, the individual resource constraint is then

$$y^i + \theta^i \cdot C(X, n, \oplus) = I^i, \quad \forall \text{ i, and } \oplus \in \Theta.$$

Incorporating the resource constraint into the consumers' utility function, it can be obtained that $v^i \equiv u^i(I^i - \theta^i \cdot C(X, n, \oplus), X, \oplus)$, $\forall$ i.

Assuming maximizing the group welfare as the goal for the member-owned organization with the financing of full cost-sharing, the organization faces the following problem:

$$\text{Max}_{\{X, n, \oplus\}} W(v^1, v^2, \ldots, v^n) \equiv$$

$$\Sigma^n_{i=1} u^i(I^i - \theta^i \cdot C(\alpha(X, n), \beta(n, X), \delta, \varepsilon(n), \oplus), X, \oplus).$$

Since the group welfare function is differentiable with respect to X, and n, but discrete with respect to $\oplus$, solving the above maximizing problem may be divided into two steps. First, given certain sharing rule $\oplus$, $\forall \oplus \in \Theta$, the organization solves for X and n the following problem:

$$\text{Max}_{\{X, n\}} \sum^{n}_{i=1} u^i(I^i - \theta^i \cdot C(\alpha(X, n), \beta(n, X), \delta, \varepsilon(n), \oplus), X, \oplus).$$

Assuming interior solutions, the associated first-order conditions are, with respect to X,

$$\sum_i [u^i_x - u^i_y \cdot \theta^i \cdot (C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x)] = 0,$$

where $u^i_x \equiv \partial u^i / \partial X$, $u^i_y \equiv \partial u^i / \partial y^i$, $C_\alpha \equiv \partial C / \partial \alpha$, and $C_\beta \equiv \partial C / \partial \beta$.

$$\Rightarrow \sum_i u^i_x = (C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x) \sum_i u^i_y \cdot \theta^i$$

$$\Rightarrow (\sum_i u^i_x) / (\sum_i \theta^i \cdot u^i_y) = C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x \qquad (4),$$

and, with respect to n,

$$- \sum_i u^i_y \cdot [\theta^i \cdot (C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon') + \theta^i_n \cdot C] = 0,$$

where $C_\varepsilon \equiv \partial C / \partial \varepsilon$, and $\theta^i_n \equiv \partial \theta^i / \partial n$.

$$\Rightarrow (C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon') \cdot \sum_i u^i_y \cdot \theta^i = - C \cdot \sum_i u^i_y \cdot \theta^i_n$$

$$\Rightarrow C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon' = C \cdot [-(\sum_i u^i_y \cdot \theta^i_n) / (\sum_i u^i_y \cdot \theta^i)] \qquad (5).$$

The solutions, given sharing rule $\oplus$, are denoted as $X^\oplus = X(I^1, I^2, \ldots, I^n, \delta; \oplus)$, and $n^\oplus = n(I^1, I^2, \ldots, I^n, \delta; \oplus)$, $\forall \oplus \in \Theta$. Plugging $X^\oplus$ and $n^\oplus$ into group welfare function to obtain $W^\oplus \equiv \sum_i u^i(I^i - \theta^i \cdot C(X^\oplus, n^\oplus; \oplus), X^\oplus; \oplus)$. The level of $W^\oplus$ stands for the welfare level given certain sharing rule $\oplus$.

The second step is to solve for optimal sharing rule, denoted as $\oplus^{**}$. Giving that $W^\oplus$ is discrete with respect to $\oplus$, the optimal solution will be as follows:

$$\oplus^{**} = \text{argmax}_{\oplus \in \Theta} W^\oplus. \qquad (6).$$

Hence, under the organizational arrangement of the member-owned organization, the optimal provision level of good X will be $X^{**} = X(I^1, I^2, \ldots, I^n, \delta; \oplus^{**})$, the optimal membership

size will be $n^{**} = n(l^1, l^2, \ldots, l^n, \delta; \oplus^{**})$, and the resulting welfare level will be $W^{**} \equiv \sum_i u^i(l^i - \theta^i \cdot C(X^{**}, n^{**}; \oplus^{**}), X^{**}; \oplus^{**})$.

To interpret, note that equation (4) may be viewed as the provision condition. To maximize the group welfare, the marginal group welfare gained due to additional consumption of good X has to equal the forgone marginal welfare due to moving resource away from good y. On the left-hand side of equation (4), the numerator is the aggregate marginal values of good X for members, and the denominator is the aggregate marginal values of good y forgone by all members for producing an additional unit of good X. This ratio depicts how the organization as a whole will agree to substitute good y for X. Note that this "group marginal rate of substitution" is different from the famous summation of individual marginal rates of substitution, proposed by Samuelson (1954).[36]

On the right-hand side of equation (4), the first part $C_\alpha \cdot \alpha_X$ is the marginal cost for producing good X, and the second $C_\beta \cdot \beta_x$ the marginal congestion cost expected to be saved due to the increased unit of X. Hence, the sum represents the true marginal cost of providing good X. Accordingly, equation (4) shows that the organization will choose the level of good X such that the "group marginal rate of substitution" equals the true marginal cost of good X.

Equation (5) may be interpreted as the membership condition. While admitting an additional member increases the costs of maintenance, congestion, and collective decision making, it may benefit all members by reducing their cost share and hence increasing their consumption of good y. More specifically, the left-hand side of equation (5) is the marginal cost, caused by maintenance, congestion, and collective decision-making, for admitting an

[36] In Samuelson's 1954 model, a common marginal rate of transformation (MRT) is assumed to exist, hence equating marginal utility of good y across consumers. In our model, there is no such an identical rate.

additional member. On the right-hand side is the saved total cost adjusted by some welfare ratio. The numerator of the ratio is the aggregate marginal values of good y gained due to the possible reduction of individual cost share by admitting an additional member. The denominator is the aggregate marginal values of good y forgone due to the increased cost of collective decision-making shared among members. Therefore, equation (5) shows that the organization will choose the membership size such that the marginal welfare gained due to reduction of cost share by an additional member equals the marginal welfare lost due to the increased total costs associated with maintenance, congestion, and collective decision making.

Equation (6) is the condition for optimal sharing rule. Since a sharing rule not only incurs enforcement cost, but also affect members' subjective feelings, the welfare-maximizing sharing rule is not necessarily the one with lowest enforcement cost. For example, if individual consumption differs sharply among members, unless costs of enforcing the benefit-based rule outweigh the benefits it generates, the simple equal-sharing rule will not be preferred.

The above first two conditions are essentially parallel to those in the club-good model built by McGuire (1974). With the assumption of identical consumers, given equal sharing (denoted as $\oplus_e$), $\theta^i = 1/n$, $\forall$ i, equation (4) and (5) become

$$\sum_i MRS^i (= n \cdot MRS) = C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x \qquad (4a)$$

and

$$C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon' = C(X, n; \oplus_e)/n \qquad (5a),$$

respectively. If we allow consumer heterogeneity, retaining the rule of equal sharing, the provision condition then becomes

$$[(\text{Avg. } MU_X)/(\text{Avg. } MU_y)] = (C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x)/n \qquad (4b)$$

where

$$\text{Avg. } MU_g \equiv (1/n)\Sigma_i u^i_g, \qquad g = X, y,$$

while the membership condition remains the same as (5a). Although different assumptions lead to different appearances of welfare maximizing conditions, the logic behind those conditions is the same: the marginal welfare gained equals the marginal welfare forgone.

One difference in the membership condition is worth mention between the models of McGuire (1974) and this paper. In this model, good X can be perfectly nonrivalrous, as a flood-control dam for example, which bears no congestion for consumption. In notation, $C_\beta \cdot \beta_n = 0$. Different from McGuire's model, even if there is no possibility for congestion, the membership size still needs to be restricted here, due to the positive marginal cost of collective decision-making for admitting additional members. As equation (5a) shows, in the case of nonrivalrous good X, optimal number of members is chosen so that marginal costs of maintenance ($C_\alpha \cdot \alpha_X$) and collective decision-making ($C_\varepsilon \cdot \varepsilon'$) equals average total costs per member. While the term "crowding" may not be appropriate for costly decision-making due to member diversity, it is instructive to compare the cost of collective decision-making with conventional congestion costs.

5.3. Organizational Choice

Without specific forms of individual utility functions, general discussion in organizational choice is tremendously difficult, owing to the enormous set of various contingencies. To simplify my modeling for organizational choice while retaining the primary themes of my theoretical analysis, I shall make several assumptions as follows. However, as mentioned at the beginning of chapter 5, the modeling in this section shall be regarded as my initial attempt in a longer-run project of a dynamic model for organizational formation and change.

First, I shall assume that $n^* \geq H$ and $n^{**} \geq H$, where n^*, n^{**} are as defined in the previous two sections. In words, accordingly, either the profit-maximizing number of customers served by a for-profit firm, or the benefit-maximizing size of membership for a member-owned organization for providing good X, is no smaller than the total number of consumers, H. Hence, either organization will always prefer larger to smaller participation of consumers in this case of H consumers.

Next, I shall assume that there exists a minimal customer base, denoted as $\tilde{n}$, for the for-profit firm producing good X such that, once the customer base is below, the for-profit firm will shut down and drop out of the market. Likewise, it is assumed that there is also a minimal membership size, denoted as $\check{n}$, for the member-owned organization such that, once the membership size is below, the member-owned organization will fail to survive. Also, it is assumed that $\tilde{n}, \check{n} \leq H$. Therefore, it is possible that, owing to insufficient market demands or supporting members, a for-profit firm or a member-owned organization fails to emerge for the provision of good X.

There are three most immediate and simple scenarios as follows before going into the discussion of some other cases with relative complexity. First of all, the market of good X produced by a for-profit firm will take place if

$$v^{i*}(n_1) > v^{i**}(n_2), \qquad \forall\, i, \text{ and } n_1 \in [\tilde{n}, H],\ n_2 \in [\tilde{n}, H]$$

where n_1 denotes the number of customers for the for-profit producer-owned firm, n_2 denotes the number of members for the member-owned organization, $v^{i*}(n_1)$ denotes the indirect utility function of consumer i under the organizational arrangement of good X provided by a producer-owned firm subjected to the constraint that the customer size $n = n_1$, and $v^{i**}(n_2)$ denotes the indirect utility function of member i consuming good X provided by a member-owned organization subjected to the constraint that the member size $n = n_2$. That

is, if a market of good X produced by a for-profit firm, once existing, results in higher utility for all consumers, then such an arrangement will be chosen. Likewise, the member-owned organization will take place if

$$v^{i*}(n_1) < v^{i**}(n_2), \qquad \forall\, i.$$

That is, if the provision of good X by a member-owned organization, once existing, results in higher utility for all consumers, then such a member-owned organization will emerge. Finally, it will not matter to the consumers which organizational arrangement is made if

$$v^{i*}(n_1) = v^{i**}(n_2), \qquad \forall\, i.$$

Then the emergence of a feasible organizational arrangement becomes undetermined in our analysis.

To further analyze some in-between scenarios in a simplified fashion, it is assumed that there are four groups of consumers among H with the different group sizes. The first group of consumers, denoted as set *A*, shares the following feature of their utility functions:

$$v^{i*}(n_1) > v^{i}(I^{i}, 0) > v^{i**}(n_2), \quad \forall\, i \in A,\ i = 1, 2, \ldots, n_A,$$

and as previously assumed, $n_1 \in [\tilde{n}, H]$, $n_2 \in [\tilde{n}, H]$. This group of consumers can be regarded as those with the "stubborn" preference for the arrangement of a for-profit firm for providing good X, since they would prefer to no consumption of good X rather than good X provided by a member-owned organization. The second group of consumers, denoted as set *B*, shares the following feature of their utility functions:

$$v^{i*}(n_1) > v^{i**}(n_2) > v^{i}(I^{i}, 0), \quad \forall\, i \in B,\ i = 1, 2, \ldots, n_B.$$

Such group of consumers would prefer a for-profit firm to a member-owned organization for the provision of good X. Also, they always prefer some to no consumption of good X, no matter how good X is provided. The third group of consumers, denoted as *C*, shares the following feature of their utility functions:

$$v^{i**}(n_2) > v^{i*}(n_1) > v^{i}(I^{i}, 0), \quad \forall\, i \in C,\ i = 1, 2, \ldots, n_C.$$

That is, this group of consumers would prefer a member-owned organization to a for-profit firm for the provision of good X. Also, they always prefer some to no consumption of good X, no matter how the good X is provided. Finally the last group of consumers, denoted as *D*, shares the following feature of their utility functions:

$$v^{i**}(n_2) > v^i(I^i, 0) > v^{i*}(n_1), \quad \forall i \in D, i = 1, 2, \ldots, n_D.$$

The last group of consumers can be regarded as those with the "stubborn" preference for the provision of good X by a member-owned organization, since they would prefer to no consumption of good X rather than good X provided by a for-profit firm. Note also that $n_A + n_B + n_C + n_D = H$.

Finally, for analytical simplicity, I assume here that any of the above four groups finds it prohibitively costly to negotiate with one another for appropriate compensations for establishing a strategic coalition, so that no group would consider managing to establish a strategic coalition. Such a strategic coalition in my opinion merits more focused treatment, which is beyond the purpose of this dissertation. Consequently, four situations may be discussed as follows.

(1) Case of $\tilde{n} < n_A + n_B$, and $\check{n} < n_C + n_D$: Consumer groups *A* and *B* would choose to buy good X from a for-profit firm, while consumer groups *C* and *D* would choose to form a member-owned organization for the provision of good X. By assumption it is prohibitively costly to manage to form a coalition (if at all possible) among different consumer groups. Hence, in the market of good X, there would be $n_A + n_B$ customers of the for-profit firm, while the membership size would also be $n_C + n_D$ for the member-owned organization.

(2) Case of $n_A + n_B < \tilde{n}$, and $\check{n} < n_C + n_D$: In this case, the minimal customer base required for the survival of a for-profit firm is greater than the total of consumer groups *A* and *B*. On the other hand, a member-owned organization appears promising since consumer

groups *C* and *D* constitute a sufficient size of membership for the establishment of a member-owned organization. Since it is prohibitively costly for groups *A* and *B* to manage to form a coalition (if at all possible) with group *C* for supporting the provision by a for-profit firm, consumer group *B* would instead choose to join the member-owned organization with consumer groups *C* and *D*. Hence, the member-owned organization would provide good X for consumers of groups *A*, *B*, and *C* as its members, while consumer group *A* would choose not to consume good X.

(3) Case of $\tilde{n} < n_A + n_B$, and $n_C + n_D < \check{n}$: In this case, the minimal size of the membership required for the survival of a member-owned organization is greater than the total of group *C* and *D*. On the other hand, the potential market demands made up of consumer groups *A* and *B* are sufficient for the survival of a for-profit firm for producing good X. Similarly, given the infeasibility of forming a coalition among groups *B*, *C*, and *D* for establishing the member-owned organization, consumer group *C* would then choose to buy good X in the market from the for-profit firm. Hence, the for-profit firm would provide good X for consumers of groups *A*, *B*, and *C*, while the remaining consumers of group *D* would choose not to consume good X.

(4) Case of $n_A + n_B < \tilde{n}$, and $n_C + n_D < \check{n}$: Given the insufficient potential base of customers or members for either a for-profit firm or member-owned organization and the prohibitive cost of forming a necessary coalition among consumer groups, neither organizational arrangement would emerge and hence no good X would be provided.

The primary theme of the above analysis is that consumers always seek a more satisfying arrangement for the purpose of their consumption, subject to various kinds of constraints. If they make some apparently less desirable choice, it is because they do not have better options. In the above analysis, negotiation cost of forming a coalition among diverse consumers and the minimal requirement of customer/member base for the survival

of a specific organization constitute some important constraints to the organizational choice for the provision of good X.

Moreover, in general it will be more/less possible for consumers to buy good X in the market when the true price p, including costs of searching and waiting, is relatively lower/higher than those costs associated with the member-owned organization for the provision. For instance, if market transaction at the market of good X is troubled by the monopolistic power so that the true price p is considerably high, we will then expect a relatively low indirect utility level for a consumer (v^{i*}), which constitute a disadvantage for the emergence of the provision by a for-profit firm. On the other hand, the cost of ownership exercising can be so enormous among some diverse members with intense interest conflicts that the resulting indirect utility level for a consumer-member (v^{i**}) is too low to make such a member-owned organization ever desirable. Consistent with the argument by McGuire (1974) on group segregation that, given certain set of assumptions, class isolation is overall efficient, this dissertation maintains that an organization owned by members of less diversity incurs lower costs of collective decision-making and may be more likely to be established due to possible higher aggregate welfare.

5.4. Organizational Alternatives Checking Transacting Problems

Price exploitation by the firm against consumers can result from many kinds of market-transacting problems. Included can be such as monopolistic powers, the informational disadvantages of consumers, consumer "lock-in" due to transaction specificity, and so on. When any of those problems prevails, the firm may obtain positive profit even in the long run. However, price exploitation increases the true price which consumers pay for, providing strong motivation for consumers to seek alternative institutional arrangements.

When such alternatives are available, there will exist a check on the firm' exploiting its consumers. That is to say, even if there is only one firm in the market, it does not necessarily result in the monopolistic exploitation against customers. Availability of alternative institutional choices provides such a check on the problems of market transacting.

On the other hand, the firm may suffer from disadvantageous position during market transacting as well. For example, problems resulting from investment specificity might be tremendously costly for the firm to prevent. As another example, the government agency might impose excessive regulations on the rate of return to the franchised firm so that the firm might lose cost-minimizing incentives. Also, politicians or bureaucrats might extort benefits of different kinds from the firm by threatening unfavorable regulatory treatment. These may significantly increase the firm's total cost and raise the price level of good X, which affects the availability of the organizational form of investor-owned firms.

To demonstrate, let π denotes the firm's profit. By definition, $\sum_i p_r \cdot \chi^i \cdot X = \pi + C^f$. Assuming there is no distributional difficulty among consumers, consumers would choose the form of the investor-owned firm if

$$\sum_i p_r \cdot \chi^i \cdot X + \sum_i p^i_t \cdot \chi^i \cdot X < C(X, n, \oplus)$$

$$\Rightarrow \pi + C^f + \sum_i p^i_t \cdot \chi^i \cdot X < C(X, n, \oplus)$$

$$\Rightarrow \pi < C(X, n, \oplus) - C^f - \sum_i p^i_t \cdot \chi^i \cdot X \qquad (7).$$

Equation (7) means that it is likely for the cost advantages of the investor-owned firm over the member-owned organization to serve as the upper bound of the firm's profit. Without cost advantages in production and exchange, the for-profit firm might cease to exist.

Although the above is a static model, it retains some room for dynamic interpretation. More specifically, this model allows the possibility of incorporating interest groups' interactions. For example, it is possible that an incumbent firm in the market of good X

would try to prevent the formation of a member-owned organization by lobbying legislation hindering new entrance. Such success may take the forms of legal prohibition, tax bias, and so on. These events may well be characterized by the raising of the total cost for a member-owned organization. For example, breaking laws is costly, requiring resources placed in bribery, preventing being caught, and the expected loss from legal punishment. Consequently, a member-owned organization becomes less likely to be established since higher transaction costs of such an institution lead to lower welfare level of resource use as shown by the negative relation between welfare and costs.

5.5. Organization-Specific Benefit

The above analysis emphasizes the role of transaction costs, such as those of collective decision-making, in determining the appropriate institutional choice. In this section, the emphasis is changed. With slight modification, the institution-specific benefits can be incorporated into the model.

To demonstrate, suppose the organizational form of the member-owned organization generates additionally the satisfaction of members for participating in and governing the organization with other people. In other word, membership itself is valuable to individuals. For example, attending meetings, assuming offices, and the like may be satisfying social activities themselves. Moreover, participating in the decision making of the organization may give members psychological satisfaction of being in control. It is assumed here that consumer i's utility is

$$U^i = U^i(y, X, \oplus, b^i), \qquad \forall\, i, \text{ and } \oplus \in \Theta,$$

where $b^i = b^i(X, n)$ represents the consumer i's extra benefit due to participating in the organization, which is assumed to be a function of provision level and membership size. For the purpose of explication, additive nature is assumed; that is,

$$U^i(y, X, \oplus, b^i) = u^i(y, X, \oplus) + b^i(X, n),$$

$\forall$ i, and $\oplus \in \Theta$. Hence, $\partial u^i/\partial b > 0$ by construction. It is also assumed that such participation benefits increase, but at a decreasing rate, as the size of the organization grows in terms of provision scale and membership size; i.e., $b^i_k \equiv \partial b^i/\partial k > 0$, and $b^i_{kk} \equiv \partial^2 b^i/(\partial k)^2 < 0$, $\forall\ k = X, n$. To illustrate, being an owner of a relatively large organization is assumed here to make one feel esteemed and admired.

Given the assumptions of the utilitarian society, and the financing of full cost-sharing, the member-owned organization attempts to maximize the group welfare:

$$\text{Max}_{\{X, n, \oplus\}}\ W(v^1, v^2, \ldots, v^n) \Rightarrow$$

$$\text{Max}_{\{X, n, \oplus\}}\ \textstyle\sum_i u^i(I^i - \theta^i \cdot C(\alpha(X, n), \beta(n, X), \delta, \varepsilon(n), \oplus), X, \oplus) + b^i(X, n).$$

This modification in the individual utility functions will lead to slightly different appearance of associated first order conditions as the following:

$$\textstyle\sum_i [u^i_x + b^i_X - u^i_y \cdot \theta^i \cdot (C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x)] = 0$$

$$\Rightarrow \textstyle\sum_i (u^i_x + b^i_X) = (C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x) \cdot \sum_i u^i_y \cdot \theta^i$$

$$\Rightarrow \textstyle\sum_i (u^i_x + b^i_X)/(\sum_i \theta^i \cdot u^i_y) = (C_\alpha \cdot \alpha_X + C_\beta \cdot \beta_x) \qquad (4'),$$

and

$$\textstyle\sum_i b^i_n - \sum_i u^i_y \cdot [\theta^i \cdot (C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon') + \theta^i_n \cdot C] = 0$$

$$\Rightarrow (C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon') \cdot \textstyle\sum_i u^i_y \cdot \theta^i = \sum_i b^i_n - C \cdot \sum_i u^i_y \cdot \theta^i_n$$

$$\Rightarrow (C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon') = (\textstyle\sum_i b^i_n - C \cdot \sum_i u^i_y \cdot \theta^i_n)/(\sum_i u^i_y \cdot \theta^i) \qquad (5'),$$

given sharing rule $\oplus \in \Theta$.

Equation (4′) differs from equation (4) only in the additional item $\sum_i b^i_X$ in the part of numerator on the left-hand side. $\sum_i b^i_X$ denotes aggregate marginal psychological benefits due to increasing one more unit of good X through the member-owned organization. Therefore, welfare maximization requires that marginal aggregate welfare cost due to providing one more unit of good X needs to equal the marginal aggregate welfare benefit coming from both direct consumption and its psychological effect. Likewise, equation (5′) shows the welfare-maximizing membership size will be so chosen that marginal aggregate welfare cost due to the increased cost of maintenance, congestion, and collective decision-making equals marginal aggregate welfare benefit resulting from both decreased sharing burden and the psychological effect of increased membership size.

With the assumption of identical individuals, given equal sharing rule $\theta^i = 1/n \ \forall \ i$, the first-order conditions, from (4′) and (5′), become

$$n\cdot(MRS_{Xy} + MRS_{by}\cdot b_X) = (C_\alpha\cdot\alpha_X + C_\beta\cdot\beta_x) \qquad (4a'),$$

and

$$(C_\alpha\cdot\alpha_n + C_\beta\cdot\beta_n + C_\varepsilon\cdot\varepsilon') = n\cdot MRS_{by}\cdot b_n + C/n \qquad (5a').$$

With diverse consumers and equal sharing, the provision condition becomes

$$[\text{Avg. } MU_X + b_X\cdot(\text{Avg. } MU_b)]/(\text{Avg. } MU_y) = (C_\alpha\cdot\alpha_X + C_\beta\cdot\beta_x)/n \qquad (4b'),$$

while membership condition remains the same as equation (5a′). Again, the only difference in each new equation is the additional item of the associated psychological effects.

Define A as the solution set under the arrangement of the member-owned organization in the absence of institution-specific benefit as the previous. That is, $A \equiv \{X^{**}, n^{**}, \oplus^{**}\}$. Then given the existence of institution-specific benefit, we know

$$\begin{aligned} \partial W/\partial X\,|_A &= \textstyle\sum_i [u^i_x + b^i_X - u^i_y\cdot\theta^i\cdot(C_\alpha\cdot\alpha_X + C_\beta\cdot\beta_x)]\,|_A \\ &= \textstyle\sum_i b^i_X\,|_A > 0, \end{aligned}$$

and

$$\partial W/\partial n \,|_A = \sum_i b^i_n - \sum_i u^i_y \cdot [\theta^i \cdot (C_\alpha \cdot \alpha_n + C_\beta \cdot \beta_n + C_\varepsilon \cdot \varepsilon') + \theta^i_n \cdot C] \,|_A$$

$$= \sum_i b^i_n > 0.$$

That is, the provision level X and membership size n with institution-specific benefit will be larger than those without. And aggregate welfare will be larger with the institution-specific benefit, which increases the possibility of being chosen relative to the case without.

5.6. A Nonprofit Organization with Pure Donation Financing

The above model may well extend to more than two organizational choices. To demonstrate, suppose there is a third arrangement, under which some consumers voluntarily donate certain amounts of their resource endowments to finance a nonprofit organization for the provision of good X. On the other hand, the nonprofit organization provides good X free of charge. This seemingly strange arrangement does have counterpart in the real world, that is, listener-supported high-culture radio broadcasting. These radio stations provide free programs, completely financed by the donations of widespread listeners.

To begin with, consider the total cost function associated with the nonprofit, denoted as C^N, and it is specified as follows:

$$C^N = C^N(\alpha(X, n), \beta(X, n), \delta^N, \phi(X, n))$$

where $\alpha(X, n)$, $\beta(X, n)$, and δ^N are defined, respectively, as the production and maintenance costs, congestion cost, and fixed transaction cost associated with the nonprofit organization, while $\phi(X, n)$ denotes the agency cost associated with capital inflexibility due to absence of patron ownership and the reluctance of management to down-sizing when necessary. Due to the possibility of transferring or imitating advantageous production techniques, $\alpha(X, n)$,

and $\beta(X, n)$ are assumed to be identical to those of other organizations. Transaction-related fixed cost δ^N is assumed to be distinctive, due to such reasons as special legal status and regulatory treatment.

The more characteristic cost element, denoted as $\phi(X, n)$, may need further explanation. Without any owner, the nonprofit organization with independent management saves the enormous costs associated with the collective donor ownership. Managers and workers are hired on a fiduciary basis for the operation of the nonprofit. On the other hand, the absence of patron ownership generates the problem of capital immobility due to the following three factors. First, the capital sources of nonprofit organizations, such as debt, donations, and retained earnings if any, are generally less responsive to rapid increases in demand than equity capital. Secondly, when demand declines, a nonprofit organization has less incentive to reduce its investment than a for-profit firm, since the former requires only positive net rate of return to survive, instead of the equilibrium net rate of return in the capital market. Moreover, the management of a nonprofit organization has a strong incentive to avoid downsizing, due to employment at stake and perhaps professional commitment, regardless of the net rate of return on capital (Hansmann (1996, pp. 240-241)). Displacing the cost of collective decision-making by numerous owners, $\phi(X, n)$ represents essentially one kind of agent costs. Here, it is assumed that ϕ is positively affected by provision level and operation scale, reflecting the downsizing inflexibility.

For the nonprofit organization with pure donation financing, the resource constraint is then

$$C^N(\alpha(X, n), \beta(X, n), \delta^N, \phi(X, n)) \leq \sum_i d^i,$$

where d^i denotes the amount of donation by the consumer i, and $d^i \in [0, I^i]$, $\forall$ i. For simplicity it is assumed that the equality holds hereafter. Since consumers' decisions are

our primary concern, the maximizing problem for the nonprofit organization is ignored here. Simply, let $D \equiv d^i + D_{-i}$, where $D_{-i} \equiv \sum_{j \neq i} q^j$. Therefore,

$$C^N(\alpha(X, n), \beta(X, n), \delta^N, \phi(X, n)) = d^i + D_{-i},$$

$$\Rightarrow X = \Psi(d^i, D_{-i}, n, \delta^N) \equiv X^N,$$

assuming $\Psi(\cdot)$ exists. That is, the provision level of good X by the nonprofit is a function of individual donations, consumer numbers, and some cost elements. Intuitively, the provision level is positively related to the amount of donations, and negatively to costs.

It is beyond this paper to investigate whether some consumers make donations due to altruism, warm glow, derivation of other private benefits such as reputation, or any other consideration.[37] In this paper, following the basic feature of joint-product model by Cornes and Sandler (1984), and "impure altruism" model by Andreoni (1990), individual i's utility function is assumed as

$$u^i = u^i(y, d^i, X), \qquad \forall\ i.$$

An individual can derive satisfaction from consuming good y, and X, and also obtain benefit from his donation. That is, $\partial u^i/\partial j > 0$, $\partial^2 u^i/(\partial j)^2 < 0$, $\forall\ j = y, d^i, X$.

The resource constraint for individual i is then

$$y^i + d^i = I^i.$$

Consequently, each individual can be viewed as solving the following maximizing problem for the amount of individual donation d:

$$\text{Max}_{\{d\}}\ u^i(I^i - d^i, d^i, X^N) \qquad \forall\ i.$$

Since donors may be so dispersed that mutual contact and influence is usually absent, Nash-behavior is assumed for consumers' donation decision. Hence, the first-order conditions are

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[37] See the survey article by Rose-Ackerman (1996) on the related literature.

$$d^i \cdot [u^i_d + u^i_x \cdot X^N_d - u^i_y] = 0, \qquad d^i \geq 0,$$

where $u^i_d = \partial u^i / \partial d$, and $X^N_d = \partial X^N / \partial d$. For a donor-consumer, $d^i > 0$, and $u^i_d + u^i_x \cdot X^N_d - u^i_y = 0$. For a non-donor, $d^i = 0$, and $u^i_d + u^i_x \cdot X^N_d - u^i_y < 0$. Consequently, non-donors can free-ride on the contribution of donators if any level of good X is provided by the nonprofit organization. When voluntary contributions are viable, the tolerance for the above potential free-riding problem might suggest that difficulties associated with collective donor ownership be more severe.

Once v^{iN} is obtained, the organizational emergence shall be analyzed as outlined in the section 5.3. Roughly speaking, a specific organizational arrangement might emerge if the total costs associated with both production and exchange are low enough so that higher value of resource uses could be realized.

As long as the relevant benefits and costs are correctly ranked or measured, the organizational outcome is in principle predictable. As previously discussed, there are some cases in which producer-owned, customer-owned organizations are prohibitively costly. Traditional charities are a conspicuous example.

While the logic behind the choice of contractual and organizational arrangements is simple, it will be challenging to rank or measure the total costs of production and exchange under different organizational alternatives. This task requires considerable understanding and knowledge about the nature and characteristics of costs incurring under different circumstances. Such understanding and knowledge must result from careful and comprehensive investigations on the real examples.

6. EMPIRICAL STUDY

For the evaluation of my previous theoretical analysis, I shall investigate the pattern of dam ownership for empirical evidences. One main reason for choosing dam provision as the subject of this empirical study is the functional versatility of dams. As commonly known, dams may perform such functions as water supply, hydroelectric generation, flood control, recreation, and so on. Dams of distinctive functions constitute different types of public goods, the provision of which may encounter different sets of organizational difficulties. Such a likely variety of organizational difficulties could bring about the advantage of facilitating my evaluation in a broader fashion.

This empirical study is organized as follows: first, the characteristics and adjustment of the data used in this study will be introduced and described in some details. Next, ten general hypotheses will be proposed for three distinctive kinds of dams' ownership arrangement, based on the theoretical underpinnings of chapter 4 and 5. Thirdly, the empirical evidences will be presented, followed by the main conclusions of this study in the last section.

6.1. Data Description and Adjustment

The data source is the National Inventory of Dams (NID), updated during 1998 and 1999 and available on the U.S. Army Corps of Engineers' web page.[38] The 1998-99 NID data contains such information as dam name, location, nearby city, owner name, ownership type, dam designer, dam type, dam purposes, year completed and modified, height,

[38] See NID web site http://crunch.tec.army.mil/nid/webpages/nid.html.

storage, surface and drainage area, source agency, and so on.[39] Among these information fields, the ownership type is especially relevant in this empirical study, serving as the evidence for evaluating my theoretical analysis in the organizational patterns of public good provision.

There are eleven purposes of dams identified in 1998-99 NID as follows: irrigation (coded as I), hydroelectricity (H), flood control (C), navigation (N), water supply (S), recreation (R), fire protection, stock, or small farm pond (P), fish and wildlife pond (F), debris control (D), tailings (T), and other (O). In the NID data, codes are concatenated if the dam has multiple purposes, with the order indicating the relative decreasing importance of the purposes. For example, SCR would mean that the dam is primarily for water supply, then for flood control, and last for recreation.

Evidently, among the eleven primary dam purposes, not all are public. For example, fire protection or farm ponds, debris control, and tailings for mining companies are highly private in nature. Since NID data does not distinguish private from public purposes, similar concerns, though of different degrees, also apply to the data of irrigation, water supply, hydroelectricity, and recreation dams, which may serve only individuals or individual businesses in many cases. Hence, the data in these categories may provide misleading evidences for the study of public good provision, the focus of this empirical study. To maintain a high degree of data relevance, those dams will be excluded from this study. Therefore, my empirical study is confined to dams with the *primary* purpose falling into the following categories: (1) navigation, (2) fish and wildlife conservation, and (3) flood control, all of which are highly public in nature.

The 1998-99 NID data divides all dams by ownership type into five main categories, including that of federal, state, local government, public utility, and private. Besides the five

[39] The detailed data dictionary is provided in the Appendix.

categories, there are also a small amount of dams with neither owner nor ownership type information. Among the five categories, public utility requires further rearrangement, since it contains primarily utilities and special districts, defined as one form of local governments by the government census in the United States. For the purpose of my study, this category will be broken into the category of federal, state, local government, or private, whenever appropriate.

Owing to the presence of *easement*,[40] there might be considerable confusion in the ownership classification of the NID data. An easement has been defined as a right, privilege, or liberty that one has in land owned by another; it is a right to a limited use in another's land for some special and definite purpose. In the case of dam provision, a flowage easement is the right that a person, or a group of persons, has to flood water on the land of another/others. It is observed that confusion of ownership classification occurs in the case of dams provided through easements held by governments on private lands. Some states classify such dams as private in NID data, while others as public. Report errors in this regard further complicate the situation. This classification confusion is expected to be considerable in the case of flood-control dams, many of which have been built under PL566 (Public Law 83-566), the Watershed Protection and Flood Prevention Acts of 1954, later amended in 1956 and 1965.[41] To avoid the above problem, the data of flood-control dams used here will be limited to some states where correction is manageable.

Moreover, I will reclassify those dams with the easement held by governments into the government ownership, as long as the easement is legally transferable. Dam facilities associated with a transferable easement held by the government may be regarded as owned in fee simple by the government, since the government could transfer the easement

[40] Easement is the term used in the common law, while *servitude* is the equivalent in the civil law.
[41] Under PL566 state or local governments share the burden of local flood-control works by providing lands, easements, and rights-of-way, while the federal government bears the entire construction cost.

to another qualified entity, such as another governmental unit, a nonprofit, or even a for-profit firm. In other words, a transferable easement in essence separates dam facilities from the ownership of land.

6.2. Proposed Hypotheses

6.2.1. Locks/dams for navigation

Inland waterways can be classified into three types: natural rivers, canalized rivers, and artificial canals. On canalized rivers, navigation is facilitated by locks, which create a series of steps for passing vessels. In the case of artificial canals, in addition to locks, storage reservoirs must be provided to feed the summit pound with enough water. Also, other reservoirs can be introduced at lower levels to meet heavier traffic movements entailing more frequent lockage operation. Therefore, locks and certain dams are primarily for the purpose of navigation.

In the United States, before the birth of rail, automobile, and air transport, water transport served as the most crucial means that has been historically credited for the opening up of the (western) interior in early nineteenth century.[42] However, the importance of inland water transport declined with the development of rail transport, which soon attained its dominance until the arrival of the motor age. Among the few exceptions, St. Lawrence Seaway and the New York State Barge Canal may be two conspicuous examples. Since some bulk commodities face less stringent time constraint in transportation, they may still find inland waterways an economical means. Such commodities include coal, petroleum, ore, grains, primary manufactured goods (e.g., paper, concrete, metals, wood products),

[42] It was said in 1812 that a good team of five or six horses would take 18 to 35 days to carry one to one and a half tons of goods between Philadelphia and Pittsburgh. See Hadfield (1981, p.192).

and so on. According to 1998-99 NID, there are 250 dams primary for navigation purpose, amounting to only 0.33% of the total dams (76,919 in number) in the United States.

With relative ease in use exclusion, the provision of locks and dams on canalized rivers or artificial canals nonetheless incurs enormous sunk costs, which are not recoverable once the transaction fails to continue afterwards. Moreover, navigation facilities generally require integral plans covering vast areas. The granting of legal monopolistic status seems inevitable. Due to the transaction difficulties of investment specificity and monopolistic power, producer ownership with little direct regulations will not be economically feasible in my analysis. Such direct regulations include the granting of provision contracts or licenses via the delegated authority, rate or rate of return regulation, and the like. Therefore, my first hypothesis is proposed as follows:

Hypothesis 1: *In the case of navigation dams/locks, for-profit producer ownership with providing navigation facilities as the main line of business will be difficult to maintain without the aid of direct regulations.*

With direct regulations aiming at solving the transaction difficulties, producer ownership turns theoretically feasible. Such feasibility has to, however, rely on appropriate regulatory regimes, favorable technological and market conditions. Take as an example the pioneer canals provision in the late eighteenth and early nineteenth centuries. Private waterway companies were constrained by engineering technology and legal inability to prevent toll evasion so that dim profitability led to lack of financial resources (Hadfield (1981, chapter 14), Shaw (1990, chapter 1)). The development and competition of rail transport further worsened the business of private canal companies. Eventually all private companies failed to survive. In theory, nonetheless, with appropriate regulations, the ownership held by for-profit firms with providing navigation facilities as the main line of business is economically feasible as long as technological, financial and other market factors are favorable.

Should exclusion be highly difficult in some special cases, it is theoretically possible to circumvent the non-excludability difficulty if navigation service can be tied within the sale of other goods/services free from the exclusion difficulty. For example, if a dam serves not only for navigation, but also for water supply for a local area, then navigation facilities can be tied within the transaction of water utilities, consumed approximately by the identical group of local interests. One implication is that, through tie-in transactions, the provision of navigation dams does not require "direct" government regulations on navigation matters. Since there is no explicit transaction of navigation facilities, necessary regulation would result mainly from the purpose of facilitating the transaction of other goods/services. Therefore, the following hypothesis is proposed.

Hypothesis 2: *In the case of navigation dams/locks, for-profit producer ownership without the aid of direction regulations may be maintained only if the service of navigation facilities can be tied within the transactions of other goods/services.*

Alternatively, provision via an organization collectively owned/controlled by the involved interests of water transport is another possibility – the exploitative incentives associated with the problems of investment specificity and monopolistic power are eliminated under such an organizational arrangement. In the United States, the navigation networks commonly covers vast areas, frequently more than one local or state jurisdiction. Examples include the network of St. Lawrence River and Great Lakes, that of Hudson River and Great Lakes, that of Mississippi River and Great Lakes, and so on. Such navigation facilities require integral planning and coordinating different local interests, the scopes of which will be far beyond local community associations. Attempts to establish a private organization matching such huge scopes is redundant since the existing government performs the similar function. Accordingly, government ownership, especially by federal

government, is arguably common in the United States. Therefore, the following hypothesis is proposed:

Hypothesis 3: *In the case of navigation dams/locks, government ownership will be a feasible organizational choice. In the United States, government ownership will generally involve federal government, unless (1) the navigation benefit is highly limited within a local or state jurisdiction, or (2) the interest of a local or state government has been long established and thus politically influential.*

Construction of navigation networks alone requires enormous financial resource, which makes it highly difficult to rely on voluntary donations. Hence, the provision of locks/dams by donation-financing nonprofit organizations is arguably rare if at all viable.

6.2.2. Dams for fish-wildlife conservation

Among the means of protecting or restoring wetlands as fish and wildlife habitats are such as plugging drainage ditches, breaking tile drainage systems, installing water control structures, re-establishing old connections with waterways, constructing off-stream livestock watering facilities, and the like. Dams built for those ends are classified as dams for fish and wildlife conservation. Dams of this sort are usually very small in size. In the United States, there are 1,016 dams primary for this purpose, accounting to 1.32% of the total of all dams in 1998-99 NID.

There exist evident transaction difficulties in the provision of conservation services by for-profit producer-owned firms. First, non-excludability difficulty is tremendous in this case, since no traceable consumption activities take place for identifying beneficiaries, so that beneficiaries can easily avoid paying for the conservation services. On the other hand, even if all beneficiaries would pay honestly for the conservation services, they would, in turn, encounter tremendous informational disadvantages in knowing whether their payments

result in any (reasonable) marginal increment to the services, occurring mostly in remote areas. For-profit firms can easily exploit their paying customers.

In theory, exclusion difficulty could be resolved if the service of fish-wildlife conservation can be tied within the sale of other goods/services with no exclusion difficulty. In the United States, fish-wildlife conservation generally takes place in remote areas, in which there may be such businesses as ranches, timber production, and so on. The addition of conservation facilities might create or enhance the recreational values of those businesses in the forms of sport fishing/hunting, wildlife viewing, and the like. Therefore, it is possible for fish-wildlife conservation to be tied within the transaction of recreational goods/services. This possibility of "tie-in" transaction immediately implies that the owners of fish-wildlife conservation dams may include farms or ranches, range-land owners, and the like, who engage in recreational business related to fish and wildlife besides their primary lines of businesses, so that the following hypothesis is proposed:

Hypothesis 4.a: *In the case of fish-wildlife conservation dams, for-profit producer ownership may be maintained only if conservation service can be tied within the transactions of other goods/services.*

When tie-in transaction is not feasible, the technical difficulties of consumer identification and exclusion prevent the emergence of for-profit producer-owned firms engaging in fish-wildlife conservation. Hence, the above hypothesis can be alternatively expressed as follows:

Hypothesis 4.b: *In the case of fish-wildlife conservation dams, for-profit producer ownership with fish-wildlife conservation as the primary line of business will be different to maintain.*

Note that there is no conceivable regulatory scheme that can resolve the non-excludability problem in this case. In contrast to the case of navigation dams/locks,

therefore, the provision of fish-wildlife conservation cannot be made feasible by governmental regulations. On the other hand, given the typically small scale of such conservation facilities, voluntary contribution/donation is a possible way of financing. Moreover, with the "non-distribution" constraint of net earnings, nonprofit organizations also provide the safeguard against the exploitative incentives resulting from the customers' informational disadvantages. Accordingly, the conservation provision is theoretically feasible by voluntary individuals or proprietors with lines of businesses unrelated to fish-wildlife conservation, or nonprofit organizations. The following hypothesis can be proposed:

Hypothesis 5: *In the case of fish-wildlife conservation dams, it is possible for the ownership to be held by (1) voluntary individuals, or proprietors in lines of business unrelated to fish-wildlife conservation, or by (2) nonprofit organizations (controlled by an autonomous board of directors/trustees).*

Alternatively, organizations under customer ownership constitute another organizational possibility, as long as the majority of involved interests support such organizational arrangements. Some sets of formal or informal rules could be established through the process of collective decision-making among the involved interests to resolve the non-excludability problem. Different ranges of involvement result in such a variety of organizational forms as community associations and governments. Accordingly, the following hypothesis can be proposed:

Hypothesis 6: *In the case of fish-wildlife conservation dams, it is possible for the ownership to be held by customer-owned/controlled organizations, such as community associations and governments.*

In the case of private customer-owned organizations such as landowners or community associations, my theory argues that such organizations must rely on favorable conditions for collective ownership. That is, the feasibility of such organizations rests on the

homogeneity of members' interests or subjective values, precluding the possibility of intense interest conflicts. With small communities or rural areas serving as the proxy of interest homogeneity, the following hypothesis is thus proposed:

Hypothesis 7: *In the case of fish-wildlife conservation dams, the ownership held by such member-owned organizations as landowner associations will be mostly found in small communities or rural areas, but not vice versa.*

6.2.3. Dams for flood control

Besides channel improvement, levees, and floodways, dams have long been another familiar way of flood control, providing temporary artificial storage of excess floodwaters for subsequent release at a rate within the capacity of the stream channel. According to 1998-99 NID, dams primary for flood control ranks the third in number (12,023), next to recreation dams and fire or farm ponds in the United States. It also means that among a hundred dams in the United States, about 15 or 16 dams are primarily for the purpose of flood control.

It is highly difficult for a private provider to directly exclude people from the non-rivalrous benefit generated by a flood-control dam once built. However, this exclusion difficulty could be circumvented if the service of flood control can be tied within the sale of other goods/services free from difficulties of use exclusion. In the case of flood-control dams, two possibilities are germane: the first involves a tie with the sale or rental of lands; flood-control dams largely enhance, or in some cases create, the residential or commercial values of nearby lands. The second is tied to the sale of the dam's other joint products, such as water utilities, which are free from exclusion difficulty and consumed by approximately the same group of customers. Dams with multiple purposes may provide such possibility.

In contrast, navigation service generally does not need to be tied within the transaction of other goods/services; exclusion of navigation benefit is relatively easy. Fish-wildlife conservation, on the other hand, generally takes place in remote areas, the residential value of which can hardly be generated by the addition of conservation facilities. Moreover, dams for fish-wildlife conservation usually do not allow for other purposes than recreation for making profit.

Two immediate implications are conceivable with those possibilities of "tie-in" transaction. First, the possible owners of flood-control dams may include those businesses involved in land development, real estate, water utilities, and the like. Another implication is, through tie-in transactions, the provision of flood-control dams does not require "direct" government regulations on flood control. Since there is no explicit transaction of flood-control service, necessary regulation would result mainly from the purpose of facilitating the transaction of other goods/services. Therefore, the following hypothesis is proposed.

Hypothesis 8.a: *In the case of flood-control dams, for-profit producer ownership may be maintained only if flood-control service can be tied within the transactions of other goods or services.*

Likewise, without the possibility of tie-in transactions, non-excludability and other transaction difficulties such as investment specificity prohibit the producer ownership. That is, the above hypothesis can be expressed alternatively as follows:

Hypothesis 8.b: *In the case of flood-control dams, for-profit producer ownership with flood-control as the only line of business will be different to maintain.*

Notably, there is no conceivable regulation or legislation that can resolve the non-excludability problem without displacing private contracting between producer-owned firms and their customers. Mandatory payment by law to the dam's provider, for instance, is essentially equivalent of taxation, eliminating the very nature of private/market transacting.

According to my theory, customer-owned/controlled organizations are another possible form of organizational arrangements; through the collective decision-making process, some formal or informal rules could be established among the involved interests to resolve the non-excludability problem. Moreover, such organizational arrangements could also avoid many transactional difficulties, since the interests of both transacting sides are highly aligned if not identical. With no opportunity of tie-in transactions, government ownership is predicted as the dominant organizational form if the threat of floods affects the voting majority of at least one governmental jurisdiction. Flood-control provision is usually easy to obtain wide support from the majority of local interests threatened by floods; it is not necessary to rely on other private associations or nonprofit organizations.

If, on the other hand, floods threaten only a small portion of the population within a governmental jurisdiction, government provision might fail to obtain enough support in the political process. With the favorable condition of interest homogeneity, community/property-owners associations may emerge for the provision of flood-control dams. The condition of interest homogeneity is usually favorable in small or rural communities, which may hence serve as the corresponding proxy variable. Owing to the urgency of possible life and/or property losses, mere reliance on donation-financing nonprofits should be rare. Insurance or moving away is more likely under this kind of circumstances.

In conclusion, some hypotheses could be proposed as follows:

Hypothesis 9: *In the case of flood-control dams without the tie-in transaction opportunities, it is possible for the ownership to be held by customer-owned/controlled organizations, such as community/property-owners associations and governments.*

Hypothesis 10: *In the case of flood-control dams without the tie-in transaction opportunities, the ownership held by such member-owned organizations as*

community/property-owners associations will take place mostly in flood-threatened small communities or rural areas, but not vice versa.

6.3. Empirical Evidences

6.3.1. Locks/dams for navigation

To reject hypothesis 1, it is necessary to show the presence of unregulated for-profit producer ownership with providing navigation facilities as the main line of business. According to the corrected 1998-99 NID data, the ownership distribution of the navigation dams in the United States is shown in figure 6.1.

Among 250 navigation dams, there are only two dams recorded as owned by private firms. Dayton dam, owned by "Midwest Hydro, Inc.," is located on Fox River in La Salle

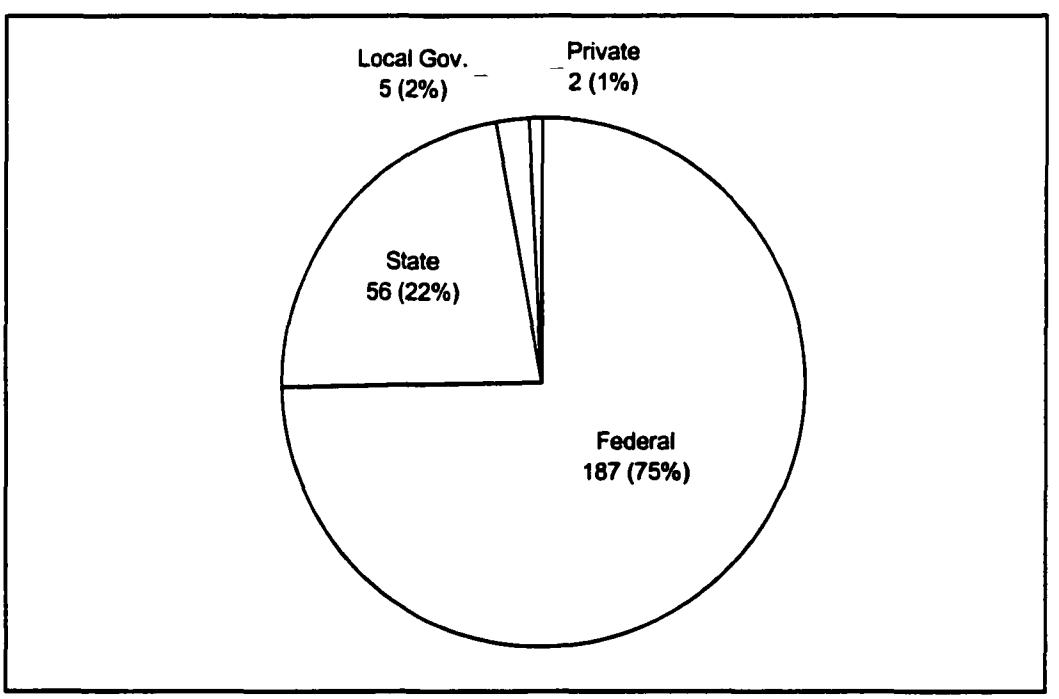

Figure 6.1. Ownership distribution of navigational dams and locks (1998-99 NID)

County of Illinois. The other, Town River Pond Dam, owned by a firm named "A.P.C. Corp.," is located in Plymouth County in Massachusetts. However, Dayton dam turns out to be a case of reporting error in the NID data. Midwest Hydro, Inc., located in Neshkoro, Wisconsin, is a hydroelectric company. Dayton dam is under the management of Midwest Hydro's Illinois agent, North American Hydro, Inc. in Winnetak, for the purpose of hydroelectric generation. As a data file of such grand scale, the 1998-99 NID inevitably contains certain level of reporting errors.

Further information about the owner of Town River Pond Dam is necessary to evaluate hypothesis 1. If A.P.C. Corp. does engage in providing navigation facilities as its main line of business without the aid of such regulations as of price or rate of return, then hypothesis 1 will become dubious. Contrarily, misreporting will be regarded as supporting evidence for hypothesis 1, while the presence of tie-in transaction will support hypothesis 2.

Hypothesis 3 consists of two parts. The first is the feasibility of the government ownership. This part is confirmed by the presence of such an organizational arrangement, as shown in figure 6.1. In 1998-99 NID, there are 248 navigation dams owned by either the federal, state, or local government, accounting to 99.2% of the total dams primarily for navigation.

The second part of hypothesis 3 maintains that the federal ownership would be largely related to the interstate nature of navigational service that the facilities bring about, unless the political influence of state or local interests upsets this pattern. One way of evaluating this portion of hypothesis is to conduct the contingency table analysis, aided with some measure of association between the interstate coverage of navigation service and the pattern of governmental ownership.

Table 6.1 presents the result of classifying the navigation dams/locks in 1998-99 NID into two types, interstate and instate, based on the navigational coverage of the involved

Table 6.1. Rivers with navigational dams/locks and their navigational coverage

State	River	Interstate	Justification
AL	Alabama River	1	System of Alabama River and its upstream Coosa River provides navigation benefit covering Alabama and Georgia.
	Black Warrior River	1/0	Connecting Tombigbee River makes it navigable to at least Tennessee River system.
	Chattahoochee River	1	Navigable Chattahoochee River involves Alabama, Georgia, and Florida.
	Tennessee River	1	In addition to connecting Ohio River system, navigation benefit covers at least Kentucky, Tennessee, and Alabama.
	Tombigbee River	1	Tombigbee River itself covers Alabama and Mississippi; with Tenessee-Tombigbee Waterway, it connects additionally Tennessee River system.
AR	Arkansas River	1	Interstate (AR, OK, KS, etc.)
	Ouachita River	1	Interstate (AR, LA)
FL	Apalachicola River	1	Apalachicola/Chattahoochee River involves Alabama, Georgia, and Florida. See AL.
	Caloosahatchee River	0	South Florida
	Oklawaha River	0	Northeastern Florida; principal tributary of St. Johns River
	Palatklakaha Creek	0	Central Florida
	St. Johns River (Offstream)	0	Northeastern Florida
	St. Lucie Canal	0	South Florida
	Withlacoochee River	0	Central Florida
GA	Savannah River	1	Bordering Georgia and South Carolina
IA	Mississippi River	1	Interstate (MN, WI, IA, IL, MO, KY, TN, AR, MS, LA)
IL	Calumet River	1	Interstate (IL, IN)
	Chicago Sanitary & Ship Canal	1	Connecting systems of Great Lakes and Mississippi River
	Des Plaines River	1	Connecting systems of Great Lakes and Mississippi River
	Fox River	0	A tributary of Illinois River
	Illinois River	1	Connecting systems of Great Lakes and Mississippi River
	Kaskaskia River	1	A tributary in South Illinois of Mississippi River

Table 6.1. (continued)

State	River	Interstate	Justification
IL	Mississippi River	1	See IA.
	Ohio River	1	Interstate (IL, KY, IN, OH, WV, PA, etc.)
KY	Barren River	1/0	A tributary of Green River; part of Ohio River system
	Green River	1	Part of Ohio River system
	Kentucky River	1	Part of Ohio River system
	Ohio River	1	See IL.
	Tennessee River	1	See AL.
LA	Black River	1	Black/Ouachita River covers Louisiana, and Arkansas.
	Ouachita River	1	Black/Ouachita River covers Louisiana, and Arkansas.
	Pearl River	1	Interstate (MS, LA)
	Pearl River Canal	1	Interstate (MS, LA)
	Red River	1	Interstate (LA, AR, TX, OK, etc.)
MA	Charles River	0	Instate
	Mystic River	0	A tributary of Charles River
	Town River	0	Instate
ME	Songo River	0	Instate
MI	St. Marys River	1	Connecting Lake Superior and Lake Huron; bordering the U.S. and Canada
MN	Mississippi River	1	See IA.
	Muskrat Lake	0	Instate
MO	Mississippi River	1	See IA.
MS	Tombigbee River	1	Interstate; see AL.
NC	Cape Fear River	1/0	Part of Atlantic Intracoastal waterway
NY	Black River	0	Instate
	Butternut Creek	0	Instate
	Champlain Canal	0	Connecting Hudson River, and lower St. Lawrance River valleys
	Chittenango Creek	0	Instate
	Clyde River	0	Instate
	Eaton Brook	0	Instate
	Erie Canal	1	Part of New York State Barge Canal; connecting systems of Hudson River and Great Lakes
	Genesee River	0	Instate
	Grindstone Creek	0	Instate
	Hudson River	1/0	Connecting Great-Lake system by New York State Barge Canal
	Limestone Creek	0	Instate

Table 6.1. (continued)

State	River	Interstate	Justification
NY	Mohawk River	1	Part of New York State Barge Canal
	New York State Barge Canal	1	Connecting systems of Hudson River and Great Lakes
	North Lake Outlet	0	Instate
	Oneida River	0	Instate
	Oswego River	0	Instate
	Payne Brook	0	Instate
	Seneca River/Canal	0	Instate
	Sand Lake	0	Instate
	Sandy Creek	0	Instate
OH	Ohio River	1	See IL.
OK	Arkansas River	1	See AR.
	Verdigris River	1	Covering Kansas and Oklahoma; part of Arkansas River system
OR	Columbia River	1	Interstate (WA, OR, etc.)
PA	Allegheny River	1	Covering New York and Pennsylvania; part of Ohio River system
	Monongahela River	1	Covering West Virginia and Pennsylvania; part of Ohio River system
	Ohio River	1	See IL.
TN	Clinch River	1/0	A tributary of Tennessee River; part of Tennessee River system
	Tennessee River	1	See AL.
	Watauga River	1/0	A tributary of Tennessee River; part of Tennessee River system
WA	Lake Washington Ship Canal	0	Instate
	Snake River	1	Interstate (ID, OR, WA, etc.)
WI	Fox River	1	Connecting Lake Michigan and Wisconsin River, a tributary of Mississippi River
	Mississippi River	1	See IA.
WV	Kanawha River	1	A tributary of Ohio River; part of Ohio River system
	Monongahela River	1	Interstate; see PA.
	Ohio River	1	See IL.
	Tygart River	1	Upstream of Monongahela River; part of Ohio River system

rivers. Among the 24 states with navigational dams/locks in the first column, there are 82 rivers and canals involved with the 248 government-owned locks/dams, as shown in the second column. The third column provides the coding of the interstate nature of navigable rivers and canals, with 1 representing interstate and 0 otherwise. Justifications for my grouping are provided in the last column. Note that in my classification there are 5 "in-between" cases, denoted as 1/0, including Black Warrior River in Alabama, Barren River in Kentucky, Cape Fear River in North Carolina, Clinch River and Watauga River in Tennessee. These 5 in-between cases therefore do not provide organizational contradiction against my hypothesis. Such consideration will be incorporated in constructing the contingency table.

The contingency table for evaluating the second portion of hypothesis 4 is presented as follows. In table 6.2, regardless of the navigational coverage variable, total federal ownership is 75.4%. In the case of interstate navigation coverage, the percentage of federal ownership is 86.8 (184 out of 212), while instate only 8.3 (3 out of 36). Evident diagonal concentration seems to suggest the hypothetical relationship between interstate coverage and federal ownership.

The conventional test in the contingency table analysis is by means of the chi-square statistic for the independence between column and row variables. The calculated value of chi-square statistic for this table is 102.142, far greater than the critical value 6.635, allowing

Table 6.2. Relationship between interstate coverage and government ownership

	Navigational Coverage		
Ownership Pattern	Interstate	Instate	Total
Federal	86.8%	8.3%	75.4%
Non-Federal	13.2%	91.7%	24.6%
Total	100.0%	100.0%	100.0%
	(n = 212)	(n = 36)	(n = 248)

a 1% chance of error, given the degree of freedom 1. Therefore, it can be inferred that a relationship exists between navigational coverage and the pattern of governmental ownership.

To assess the strength of the association between column and row variables, the most frequently used measure of association, *Cremer's V*, is chosen here. Based on the chi-square statistic, the formula of *Cremer's V*, denoted as *V*, is given as follows:

$$V = \text{square root of [chi-square}/(m \cdot n)]$$

where chi-square = value of chi-square statistic calculed for the contingency table, m = min[(number of rows in the table –1), (number of columns in the table –1)], and n denotes the sample size. The measure ranges from 0, indicating no relationship, to 1, a perfect relationship between the variables. For table 6.2, the *Cremer's V* is 0.64, indicating a perceivable, though perhaps mild, relationship between navigational coverage and the pattern of governmental ownership.

Evaluating hypothesis 3 would become more thorough once we take into account the long established state interests, well documented in history, of New York government in the development of inland waterway system since the unique success of Erie Canal. New York State has had the most extensive inland waterway system in the United States, since the completion of New York State Barge Canal System in 1918. Among the 49 navigational dams/locks in 1998-99 NID data, 47 are owned by the state government, one city-owned, and one federal-owned. However, there are 26 dams/locks associated with those rivers and canals that are highly interstate in terms of their navigational impacts. Hypothesis 3 suggests that the relationship between interstate coverage and federal ownership should become more evident once the influential state or local interests are ruled out.

Singling out the data of New York State, I derive a new contingency table as follows. In table 6.3, the percentage of total federal ownership rises from 75.4 to 93.5, whereas the

Table 6.3. Relationship between interstate coverage and government ownership (Without New York State data)

Ownership Pattern	Navigational Coverage		Total
	Interstate	Instate	
Federal	98.4%	23.1%	93.5%
Non-Federal	1.6%	76.9%	6.5%
Total	100.0%	100.0%	100.0%
	(n = 186)	(n = 13)	(n = 199)

federal ownership in the category of interstate coverage also rises dramatically from 86.8 to 98.4. This suggests that the dam ownership held by New York State obscures to some extent the relationship of federal ownership with interstate navigation in the NID data. On the other hand, in the category of instate coverage, the percentage of federal ownership also rises from 8.3 to 23.1 when New York State is excluded. It appears that the federal government has been more involved in instate navigation than shown in table 6.2, which could suggest the possibility of the long criticized federal over-involvement, resulting from so-called "pork-barrel politics."

The calculated chi-square statistic for this new table is 112.865, rejecting once again the hypothetical independence between navigational coverage and ownership pattern at the significant level of 1%. The measure of association, *Cremer's V*, now increases to 0.75, indicating a much more apparent relationship between federal ownership and interstate navigation, when New York State is excluded. Higher *Cremer's V* makes doubtful the criticism of the federal over-involvement. First, the total number of instate navigation coverage is so greatly reduced that even one additional case of the federal involvement in instate navigation will dramatically increase its share in percentage, as shown in the new contingency table. Moreover, the total number of non-federal ownership is now so low that it becomes especially dramatic to have 76.9% (10 out of 13) of instate navigation facilities under non-federal ownership. Hence, 23.1% (3 out of 13) of federal involvement in instate

navigation alone is not convincing evidence to endorse the criticism of the federal over-involvement.

In summary, the above contingency table analysis supports (or fails to reject) hypothesis 3. On the one hand, the federal ownership is largely related to the interstate coverage of navigational facilities, while, on the other, this relationship is more evident once the influence of established state/local interests is reduced.

6.3.2. Dams for fish-wildlife conservation

Logically it will be sufficient for rejecting hypothesis 4.a and 4.b to show the presence of for-profit producer ownership with fish-wildlife conservation as the main line of business. Partial confirmation of hypothesis 4 will result if there is no conflicting case in 1998-99 NID data.

The distribution of ownership types is shown in figure 6.2, which provides a pie chart for the ownership distribution of dams for fish-wildlife conservation. In figure 6.2, the government ownership, including federal, state, and local governments, accounts for 396 cases or about 39 in percentage, while the private ownership accounts for 309 cases or about 30.4 in percentage. There are also 311 dams without the specification of ownership type.

Although the 1998-99 NID data does not contain the information about the lines of businesses in which owners are engaged, some names of the private dam owners evidently indicate the associated lines of businesses. For example, the main business line of Ragley Lumber Company or International Paper Company is self-evident. Among those owners with lines of businesses identifiable by their names, there are no for-profit firms with fish-wildlife conservation as its primary business. The summary table is provided in table 6.4. On the other hand, cases for the fish-wildlife conservation via tie-in transaction are

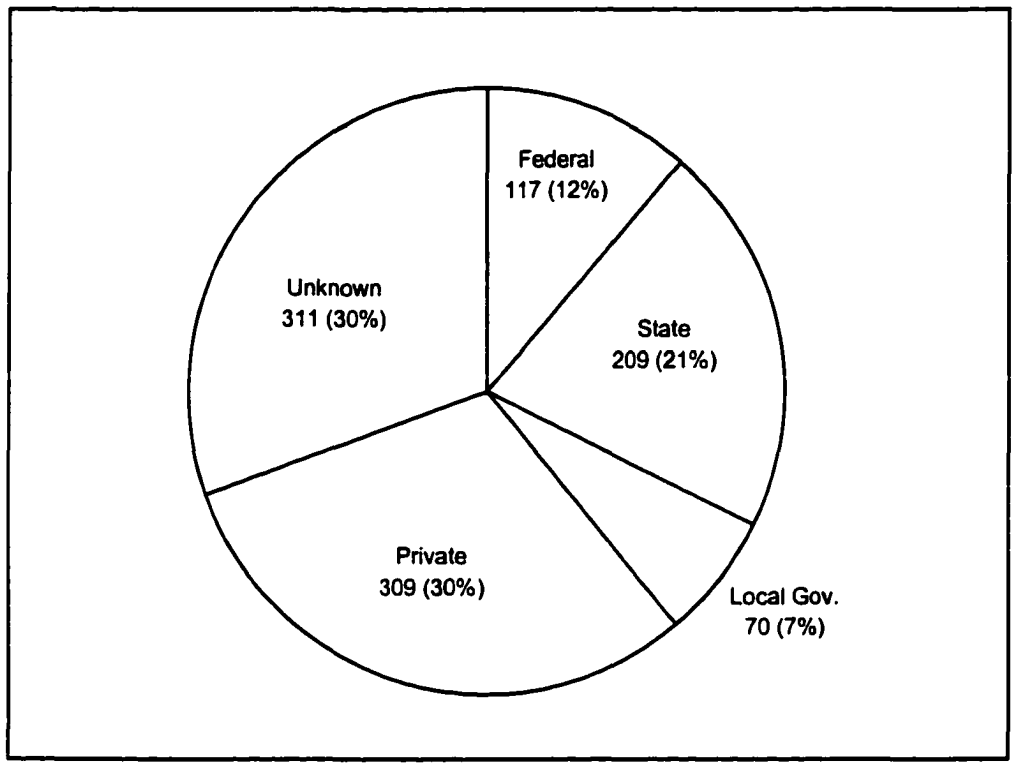

Figure 6.2. Ownership distribution of fish-wildlife conservation dams (1998-99 NID)

observed. As shown in the NID data, some private resorts own dams for recreational purposes with the function of fish and wildlife conservation. For example, in La Plata County of Colorado, Warner #5 dam is owned by Advanced Marketing Seminars, Inc., a private resort designed for training and conference operations, while serving as one of recreational facilities within the resort. As another example, Trail Creek dam is owned by Sun Valley Company, a famous summer and winter resort in Blaine County of Idaho. While noted as a ski resort, Sun Valley in summertime provides for horseback riding, trap and skeet shooting, in and outdoor ice skating, swimming, fly fishing, biking, and so on. Fish-wildlife conservation of the dam is made possible through the recreational business.

Some farms or ranches, besides their farming or raising livestock, also provide recreational lodging/camping, fishing, and so on, with the involvement of dams. Spanish

Table 6.4. The private owners of dams for fish-wildlife conservation in 1998-99 NID

State	Owner	Dam name
AZ	McLellan Lake Properties, Inc.	McLellan
CO	Crystal Lakes Water & Sewer Association	Lone Pine
	Metroz Park & Lake Co.	Metroz Park, Lower
	Lake Maria Grazing	Maria
	Red Feather Lakes Storage & Irrigation Co.	Mitchell #1; Nakomis Lake
	Advanced Marketing Seminars, Inc.	Warner #5
	Pagosa Lakes Property Owners Association	Linn and Clark; Lake Forest
	Battle Mountain Co. (Ranch)	Upper Cogdill
	Cross Bar X Youth Ranch	Charles Lemon R R
	Spanish Peaks Ranch	Spanish Peaks Ranch #13
	Bessie Goldsworthy Inter-Vivos Trust	Cushman
	Colorado Trout	Lake Manchester
	Diamond S Ranch	Brush Fence Lake; Native Lake
	Otis Company – Lazy O Ranch	Lazy O Reservoir #2
	Black Diamond Mine Ranch	Flannery
	Silver Lakes Trout Club	Silver Lakes #2
CT	Bristol Fish & Game	Bristol Fish & Game
	Remington Arms Company, Inc.	Success Lake
	Norman Thompson (The Thompson Corp.)	Lemanquis Dam
	Flanders Nature Center	Flanders Wildlife Center
	Northeast Audubon	Ford Pond
	Hartford Neighborhood Services	Hihoti Dam
DE	Port Penn Hunting Club Inc	Canal Farms Dam
GA	Millhaven Company	Baker Pond
	Yellow River Farms	Yellow River Farm Pond Dam
IA	K-F Farms	K-F Farms 1
	Templeton Farms Inc.	Templeton Farms Inc.
ID	Sun Valley Co., Inc.	Trail Creek
IN	Bittersweet Moors Community Association	Bittersweet Lake Dam
LA	Cypress Black Bayou Lake Commission	Cypress Bayou #2
	Calcasieu Marine National Bank	Bear Creek #3
	The Howard Corporation	Bear Creek #2
	Ragley Lumber Co. c/o Frank Pruitt	Bear Creek #1
	Ajax Realty Company, Inc.	Bayou Dupont #17
MA	Audubon Society	Wasseka Wildlife Sanctuary
ME	Peabody Pond Association/Acorn Assoc. Cape Elizabeth	Peabody Pond
	IP Timberlands Operat. Co., Ltd/Megantic Fish & Game	Massachusetts Bog Dam; Long Pond Dam; Little Island Pond Dam
	IP Timberlands Operat. Co., Ltd	Spring Lake Outlet Dam
MS	Castlewood Land Development Corporation	Dam D

Table 6.4. (continued)

State	Owner	Dam name
ND	Tuttle Wildlife Club	Lake Josephine
	Turnbow Development corporation	Turnbow Development corporation
	Wetzstein Bros	Wetzstein Bros Ranch Dam
	Basin Electric	Glen Harold Mine Coyote 4
	Van Ray Farms	Van Ray Farms Dam 2
NY	Oneida Community Ltd.	Oneida Ltd Dam #3
OK	WDW Ranch	SCS-WDW Ranch 1
OR	International Paper	Gardiner Reservoir
	GI Ranch Corporation	Black Snag Reservoir
	Baker West, Inc.	Baker West Nursery Dam
PA	Butler City H&F Club	Butler Hunt Club
	B & B Sportsmans	Lee Smith Dam
SC	Union Camp Corp.	Palmetto Bluff Plant Dam 1
	Mackey Point Plantation	Mackey Point Plantation Dam
	Mount Vintage Properties	Mount Vintage Dam
SD	May & Sons Inc.	May & Sons Dam
	Dakota Hunt Preserve Association	Velda Ramser Dam
	Two Bar Two Grazing Association	Two Bar Two Grazing Association Dam
TX	Montex Drilling Company	Lake Mullet Dam; Lake Montex Dam; Lake Moncrief Dam
	Conoco, Inc.	Conoco Lake #1 Dam
	Lakeview Estates	Lakeview Estates Dam
WI	St. Cloud	Mischos
	Mineral Point	Hidden Valley Farms
WY	George B. Storer (Old Baldy Club)	Lake George
	Haub Bros Enterprises Trust	Sunset
	True Ranches, Inc. (Toby Wingert)	Hirsig #4
	Federated Mutual Life Insurance (John Buxton)	Alvie #1
	Reeves Inc. (O. W. Reeves)	Reeves #1
	High Mountain Ranches Inc.	Hillhouse Pond
	Wyo. Game & Fish	White Wetlands

Peaks Ranch #13 (in Las Animas County of Colorado), for instance, is owned by Spanish Peaks Ranch for the purposes of fish-wildlife conservation, recreation, and water supply. Similar examples, among others, include Yellow River Farm Pond Dam (in Newton County of Georgia) owned by Yellow River Farms, and Black Snag Reservoir (in Crook County of Oregon) owned by GI Ranch Corporation.

In conclusion, hypothesis 4.a and 4.b are supported by the NID data for (1) the absence of for-profit producer ownership with fish-wildlife conservation as the main line of business, and (2) the evident presence of for-profit producer ownership with fish-wildlife conservation via tie-in transaction in the 1998-99 NID. In other words, this study fails to find any evidence for rejecting hypothesis 4 as a whole.

Hypothesis 5 can be confirmed by the presence of a voluntary individual, proprietor with lines of business unrelated to fish-wildlife conservation, or nonprofit organization. As shown in 1998-99 NID data, some dams of fish-wildlife conservation are owned by nonprofit organizations. Examples, among others, include Lake Manchester Dam (in Gilpin County of Colorado) owned by Colorado Trout Unlimited, Flanders Wildlife Center dam (in Litchfield County of Connecticut) owned by Flanders Nature Center, and Wasseka Wildlife Sanctuary (in Middlesex County of Massachusetts) owned by National Audobon Society.

Although there are no owner information other than their names for many privately owned dams of fish-wildlife conservation in 1998-99 NID, the presence of voluntary contributions from individuals and proprietors is suggested by the Partners-for-Fish-and-Wildlife-Program administered by the federal agency U.S. Fish and Wildlife Service. By means of this program U.S. Fish and Wildlife Service has been offering technical and financial assistance to private landowners to voluntarily restore wetlands and other fish and

wildlife habitats on their land. Among the private landowners as partners in this program are individuals, proprietors, corporations, private organizations, and educational institutions.[43]

Further confirmation can result from individually investigating those dam owners. Take for example the Consolidated Coal Pond #003 in Ward County of North Dakota. This pond, at the closed Velva Mine, is a former sedimentation pond now retained as a permanent structure to provide a water source for livestock and wildlife. The pond is located on tracts of land owned by the Consolidation Coal Company and by an individual. Hence, the owner is recorded as "Consolidated Coal Co & priv(ate)" in 1998-99 NID. It is also known that an area farmer is now in the process of purchasing both tracts of land under a contract for deed.

As another example, Turnbow Development Corporation dam (in Burleigh County of North Dakota) is recorded as owned by Turnbow Development Corporation in the NID. The construction of the dam resulted from the wetland mitigation project associated with the residential development by the corporation along the Missouri River. The dam serves for the conservation of the affected wetlands by the residential development.[44]

Similarly, hypothesis 6 is confirmed by the presence of the dam ownership held by such organizations as landowner/community associations and governments. As previously shown in figure 6.2, there are 396 fish-wildlife conservation dams owned by either the federal, state, or local governments. Moreover, the ownership held by member-owned organizations is also evident in 1998-99 NID data. Community or property owners associations constitute one of such examples. As shown in the NID, for instance, Lake Forest Dam (in Archuleta County of Colorado) is owned by Pagosa Lakes Property Owners Association, Bittersweet Lake Dam (in Allen County of Indiana) owned by Bittersweet Moors

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[43] For more information about this program, see the web site http://partners.fws.gov.

[44] For the information of the above two examples, I would like to thank Jim Deutsch, director of Reclamation Division at North Dakota Public Service Commission.

Community Association, and Peabody Pond dam (in Cumberland County of Maine) owned by Peabody Pond Association and others.

Moreover, the NID data shows that many dams for fish and wildlife conservation are owned by fishing and/or hunting clubs of close membership. For example, the impounded Silver Lakes #2 (in Conejos County of Colorado) is owned by Silver Lakes Trout Club exclusively for the use of its members. According to the club manager in the phone interview, there are now 35 members, most of which are out-of-state. All members have their cottages as private property around the lakes and collectively own the rest of land and facilities. If a member decides to terminate the membership, it could sell its cottage to someone approved by all other members. The sale price of the cottage will take into account all the collectively owned durable assets. Evidently, the inclusion in the membership of private cottages circumvents conceivable difficulties resulting from otherwise. In conclusion, the above evidences support the theoretical possibility maintained by hypothesis 6.

Hypothesis 7 maintains that the presence of a member-owned organization such as community or property-owners associations implies the favorable conditions for the member homogeneity, but the later does not imply the former. For the identifiable (by name) organizations of such kind, a summary table is established as follows.

Table 6.5. Community associations and its rural/small feature (fish-wildlife conservation)

State	Name of community association	Rural/small
CO	Pagosa Lakes Property Owners Association	1
	Lake Maria Grazing Association	1
IN	Bittersweet Moors Community Association	1
ME	Peabody Pond Association/ Acorn Association Cape Elizabeth	1
NY	Oneida Community Ltd.	1
SD	Two Bar Two Grazing Association	1

In table 6.5, the first two columns show the identified community associations as the owners of dams for fish and wildlife conservation in the 1998-99 NID, and the located states. The third column presents the coding of rural or small feature of the associated communities, with 1 representing rural/small and 0 otherwise. As shown in the table, all identified community or property-owners associations are located in rural or small communities.

For count data, one of the most common tests concerns the parameter θ of the binomial distribution, where θ denotes the possibility of a success. This test is based on the assumption that θ is the same for each trial, and the trials are all independent. This assumption seems appropriate here. First, hypothesis 7 maintains that the high degree of the consistency between community associations and their rural/small feature be universal, implying a common possibility. Moreover, there is no obvious reason for believing that one association's feature depends on another's.

Therefore, the null hypothesis of no such consistency can be tested against the alternative. That is, if there is no such consistency between community associations and their rural/small feature, we shall expect similar numbers between rural/small and otherwise of those six cases in table 6.5. For the null hypothesis, accordingly, θ is assumed to be one half. All of those 6 identified cases in the NID are rural/small, resulting in the *P*-value of 0.0156. It means that the chance is merely 1.56 out of a hundred for obtaining such a radical sample when θ is one half. Such a low *P*-value makes it difficult to accept the null hypothesis. Contrarily, the *P*-value of 0.0156 suggests that the consistency is highly likely between community associations and their rural/small feature, as maintained by the hypothesis 7.

6.3.3. Dams for flood control

Logically it will be enough for rejecting hypothesis 8.a and 8.b to show the presence of for-profit producer ownership with flood-control service as the main line of business. Confirmation to certain degree of hypothesis 8 will result if there is no conflicting case in 1998-99 NID data.

Given the possible classification problem mentioned in section 6.1, the empirical data for the flood-control dams is confined to the following three states: California, Illinois, and Maine. The corresponding distribution of ownership patterns is shown in figure 6.3. In figure 6.3, the ownership held by local governments has a dominating share (about 60%), while the governmental ownership in total accounts for about 76%. On the other hand,

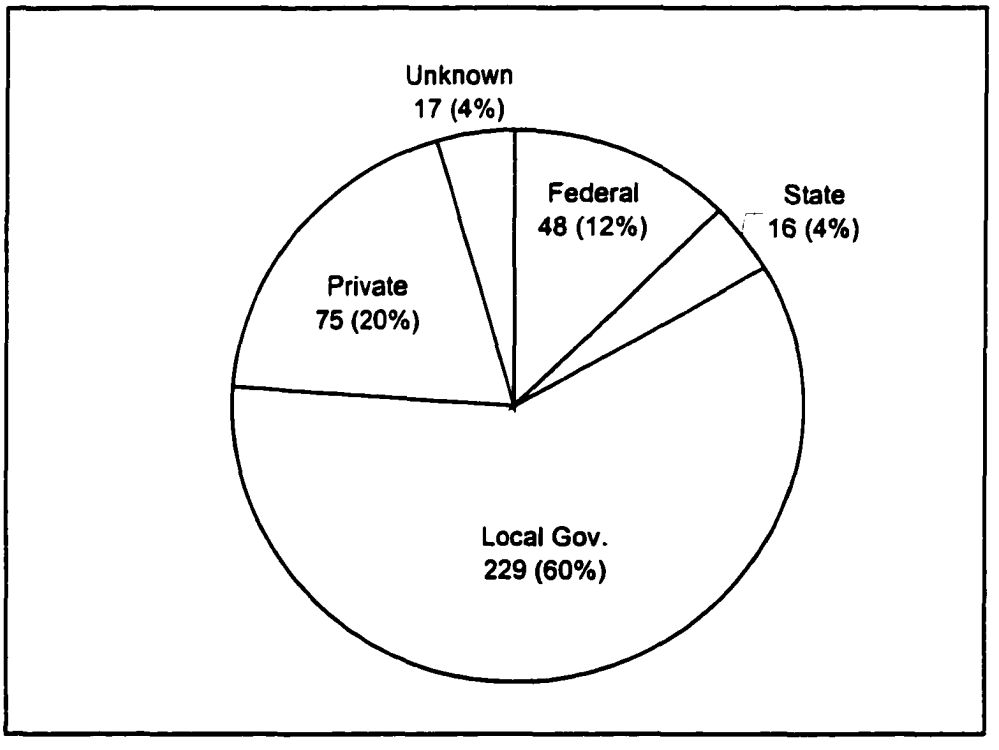

Figure 6.3. Ownership distribution of flood-control dams (1998-99 NID of California, Illinois, Maine)

private ownership amounts to about 20% of flood control dams. Finally there are also about 4% with no specification of ownership type.

Among those owners with names indicating the associated lines of businesses, there is no for-profit firm with flood control as its main business. The summary table is provided in table 6.6. *On the other hand, tie-in transaction makes possible for-profit producer* ownership. Tie-in transaction via real estate, as previously discussed, is supported by the NID. In the process of land development from site selection and purchase to construction to buildings sale/rental, land developers or real estate business companies may become involved in the ownership of flood-control dams in their development projects. Evidences include flood-control facilities of Orchard Estates (in Orange County near Tusin of California) owned by the Irvine Company, Lang Ranch Retention Basin (in Ventura County near Thousand Oaks of California), Brookwood Trace Dam (in Will County near Naperville of Illinois) owned by Oliver Hoffmann Corporation, and so on.

Moreover, tie-in transaction via other utilities involving dams is also supported by the NID. For example, Last Chance Weir and Peoples Weir (both in Kings County of California) are owned by Last Chance Water Ditch Company and Peoples Ditch Company, respectively. Last Chance Water Ditch Company engages in the business of water and sewage utilities, while Peoples Ditch Company is a ditching contractor. These two dams are recorded as for the purposes of flood control and irrigation in the 1998-99 NID.

On the other hand, there also exist some reporting errors. Consider the Crawford Ranch dam owned by McDowell Valley Vineyards in Mendocino County of California. Although recorded as primary for flood control and irrigation, the dam owner maintained the purposes of irrigation and frost prevention, while firmly denying the function of flood control in the phone interview. Take as another example the Freeman United Industry Pond 20, owned by Freeman-United Coal Mining Company in McDonough County of Illinois. The

Table 6.6. Private owners of flood-control dams and their business lines

State	Private Dam Owner	Business lines
CA	HFH, Ltd.	Land development and/or real estate management
	The Irvine Company	
	The Lang Ranch Company	
	Dove Canyon Company	
	KALOKO Land Corporation	
	Last Chance Water Ditch Company	Water and/or sewage utilities and/or ditching contractors
	Peoples Ditch Company	
	Big Valley Mutual Water Co	
	Fee Ranch Inc & P H Peterson	Farms or ranches
	Magoon Estate Ltd.	
	McDowell Valley Vineyards	
	JG Four Ranch	
	Northfork Ranch Company	
	Fellowship of Friends	Religious organizations
IL	Oliver Hoffmann Corporation	Land development and/or real estate management
	Carol Stream Partners, Inc.	Farms or ranches
	Freeman United Coal Mining Company	Coal mining
	Glen Manufacturing Company	Mechanical manufacturers
	Highland Community College	Education institutions
	North Point Property Owners Association	Community Associations
ME	Eastern Fine Paper Inc.	Pulp and Paper manufacturers
	Lincoln Pulp and Paper Co.	
	Echo Lake Association	Community Associations
	Forest Lake Association	
	Torsey Pond Association	

company maintained in the phone interview that all of their dams were for the purpose of sediment control, instead of flood control.

Hypothesis 9 is confirmed by the presence of the dam ownership held by such organizations as community/property-owners associations and governments. The presence of government ownership has been shown in figure 6.3. Examples of dam ownership held by community associations in the 1998-99 NID of California, Illinois, and Maine include as follows: North Pointe Lake Dam (in McLean County of Illinois) owned by North Point

Property Owners Association, Forest Lake Dam (in Cumberland County of Maine) owned by Forest Lake Association, Torsey Pond Dam (in Kennebec County of Maine) owned by Torsey Pond Association, and Echo Lake Dam (in Kennebec County of Maine) owned by Echo Lake Association.

Hypothesis 10 maintains that the presence of a member-owned organization such as community or property-owners associations implies the favorable conditions for the member homogeneity, but the later does not imply the former. For the identifiable (by name) organizations of such kind, a summary table is established as follows.

Parallel to the previous table 6.5 in section 6.3.2, the first two columns of table 6.7 show the identified community associations as the owners of dams for fish and wildlife conservation in the 1998-99 NID, and the located states. The third column presents the coding of rural or small feature of the associated communities, with 1 representing rural/small and 0 otherwise. As shown in the table, all identified community or property-owners associations are located in rural or small communities.

Once again, the test concerning the parameter θ of the binomial distribution is applied here. The null hypothesis of no such consistency can be tested against the alternative. If there is no such consistency between community associations and their rural/small feature, we shall expect similar numbers between rural/small and otherwise of those 5 cases in table 6.7. For the null hypothesis, θ is assumed to be one half. All of those

Table 6.7. Community associations and its rural/small feature (flood control dams)

State	Name of community association	Rural/small
CA	Igo-Ono Community Services	1
IL	North Point Property Owners Association	1
ME	Echo Lake Association	1
	Forest Lake Association	1
	Torsey Pond Association	1

five identified cases in the NID are rural/small, resulting in the *P*-value of 0.0312. It means that the chance is 3.12 out of a hundred for obtaining such a uniform outcome when θ is one half. Such a *P*-value makes it difficult to accept the null hypothesis. Contrarily, the *P*-value of 0.0312 suggests that the consistency is highly likely between community associations and their rural/small feature, as maintained by the hypothesis 10.

6.4. Empirical Conclusions

The ten hypotheses in the section 6.2 are the direct theoretical implications derived from the theory presented in chapter 4 and 5. All hypotheses are supported by the 1998-99 NID data, as shown in the previous section 6.3. These ten hypotheses lead to some highly definite conclusions, especially when we group them into three sets and make comparison among the three.

First of all, in the case of navigational dams/locks, I propose that regulated for-profit producer ownership, and government ownership are among the most feasible ownership arrangements. The difficulties for the for-profit producer ownership are not in non-excludability, but in investment specificity and monopolistic power. In theory, regulations can eliminate the difficulties and preserve the well-known efficiency associated with profit-maximizing incentives. However, appropriate regulations do not come from nowhere; they relies on certain conditions such as technological, regulatory, and financial advances. When favorable conditions are not available, government ownership becomes the most dominant, if not sole, arrangement for the provision of navigational facilities. Given the scale of navigational influence, especially in the United States, private member-owned organizations become less possible and/or redundant. Therefore, the organizational distinction from the other two cases of dams lies in (1) the possibility of regulated for-profit producer ownership,

and (2) the paucity of private customer-owned organizations. However, the theoretical possibility of regulated for-profit producer ownership is yet to be confirmed.

In the case of flood-control dams, non-excludability is the major obstacle against the for-profit producer ownership. No workable regulation is conceivable without displacing the very nature of private contracting. Tie-in transaction becomes the only room for the foothold of for-profit producer ownership. Tie-in transaction in this case takes a variety of forms, including real estate, other utilities involving dam facilities, and so on. When tie-in transaction is not available, the only chance for private ownership is by private member-owned organizations. The feasibility of such organizations depends on the member homogeneity. In other words, if there is serious interest conflict among members, such organizations may fail to emerge. Frequently, the larger size of the involved interests, the more likely the interest diversity and conflict will result. When conditions are not favorable for the above two ownership arrangements, either government ownership or no provision will be the likely outcome.

Finally, dams for fish-wildlife conservation is similar to flood-control dams in that non-excludability, complicated by the problem of consumer identification, constitutes the major obstacle for the for-profit producer ownership. Therefore, tie-in transaction and private member-owned organizations are among the ways by which private ownership could take place. The most special feature for the ownership of fish-wildlife conservation dams lies on significantly higher possibility of voluntary contribution by nonprofit individuals and organizations. Given the possibility of voluntary contribution, nonprofit organizations circumvent the difficulties of non-excludability and collective ownership held by those transient and disperse donors, at the price of attenuated efficiency owing to lack of profit-seeking incentives. Ruling out the above three ownership arrangements, either government ownership or no provision will be the likely outcome.

7. CONCLUSION

Since Paul Samuelson raised the profound issue of joint consumption about half a century ago, the public good provision has long been one hotly debated subject in economics. The definitional generalization by impure public goods makes the concept of public goods cover a wide range of goods and services, based on different degrees of non-rivalry and non-excludability. While many researchers have recognized the establishment and enforcement of exclusive rules as the subjects of choice, few pay attention to the endogenous nature of non-rivalry characteristic. As discussed in chapter 3, non-rivalry characteristic of a public good should not be taken as predetermined by its inherent physical nature. For example, when a durable or renewable resource is shared among people, its public feature is then created. In the most general sense, all forms of cooperation create public benefits and/or costs. Attention should be paid to the reason why people share or cooperate, and how. Both are the integral parts of the public good problem. This view shall facilitate our analysis in whether and what kind of public goods may be provided.

Hansmann (1996) is the first to propose a broad organizational classification, based on the ownership arrangement, to include most kinds of organizations. In my dissertation, I extend his classification to include *all* kinds of organizations in the system of private property. Government is essentially a customer/member-owned organizations, in which taxpayers as the customers of governmental services delegate most of their control rights to politicians, who in turn delegate part of the authority to the administrative bureaucrats/agents. In terms of ownership structure, government is not different from other private customer-owned organizations such as community associations. To my knowledge, this extended organizational perspective is the first that ever classifies all kinds of

organizations in a unified theoretical framework, based on the arrangements of property rights.

In the world of specialization and division of labor, the provision of goods/services involves the organizational arrangements of production and exchange. In the process of production and exchange, owners of various factors of production and consumers are connected within an organization either by way of ownership holding or marketing contracting. Different classes of the involved interests (patrons) may have different advantages or disadvantages in exercising their property rights as owners, or making market contracting. Therefore, different ownership (and thus market contracting) arrangements will result in different organizational efficiencies. The above comprehensive organizational perspective enables us to examine all the alternatives and make better predictions about the organizational patterns.

Non-excludability is the well-known difficulty featuring public goods. However, non-excludability is but one possible difficulty in the transacting process between producers and consumers for public goods. To study the organizational arrangements of public good provision, investigation in other transacting difficulties than non-excludability is inevitable. In other words, non-excludability as an explanatory factor is not sufficient for analyzing and predicting the organizational patterns in a thorough fashion.

The concept of impure public goods suggests that non-excludability does not always constitute the major obstacles. When exclusion is relatively easy, and other transacting difficulties are absent, for-profit producer-owned organizations will dominate in most cases, arguably owing to the efficiency resulting from the profit-maximizing incentive and owner homogeneity. Such a class of owners as investors is highly homogeneous and shares among them the clear goal, e.g., maximizing the return of their capital. The advantage of

ownership exercising by such a homogenous class of owners is the primary reason for the success of investor-owned firms.

On the other hand, when there exist such transacting problems as investment specificity, monopolistic power, informational asymmetry, and so on, the cost of market contracting become enormous between producers and their customers. Those transacting difficulties are the obstacles against for-profit producer-owned organizations. Moreover, for-profit producer-owned organizations are driven by the profitability of their markets. If market demands are too limited to guarantee at least the same rate of returns as for investment elsewhere, for-profit producer-owned firms will be driven away.

Customer-owned organizations have evident advantages over producer-owned organizations when the above transacting difficulties or lack of profitability prevail. The exploitative incentive is largely mitigated under the arrangement of customer ownership since the interests of both transacting sides are highly aligned, if not identical, in this way. However, customer group as the business owners is in general more diverse and heterogeneous, compared with the producer owners such as investors. Therefore, customer-owned organizations will be a more efficient organizational alternative only when the circumvention of transacting difficulties leads to higher benefit than the increased cost of collective ownership exercising among relative diverse owners. On the other hand, in the markets lacking profitability, customer-owned organizations might become the only choice, since for-profit producer-owned organizations are not available.

Taking into account the difficulty of collective ownership by diverse owners, another scenario is conceivable. When difficulties of both market contracting and ownership exercising are prohibitive, nonprofit organizations with absence of patron ownership may become relatively efficient. The absence of patron ownership avoids the cost of collective decision-making among diverse customers and eliminates the exploitative incentive

associated with producer ownership. However, without the above difficulties in market transaction and collective ownership, the inefficiency of nonprofit organizations owing to lack of profit-seeking incentive will become difficult to justify. Moreover, another disadvantage of such organizations is their reliance on the voluntary contributions, which may not always provide appropriate financing.

In theory, some governmental regulations, such as price regulation, mandate informational revelation, and so on, may eliminate such transacting difficulties as investment specificity, monopolistic power, informational asymmetry, and so on. Therefore, once established, governmental regulations might enhance the viability of producer-owned organizations. However, such changes could greatly affect some interests long established before the presence of regulations. In the example of introducing regulated private toll ways, such interests as trucking business and governmental officials associations were observed to be among the strongly opposed. Therefore, establishing governmental regulations may involve intense competition among different interests. Given different competitive advantages of different interests under different circumstances, ideal regulations may fail to emerge in the political process from time to time. Such failure results essentially from the prohibitive cost of settling the interest conflicts in the real world.

When non-excludability constitutes the major obstacle in the transacting process, for-profit producer-owned organizations will find it difficult to secure their profitability. In my dissertation, I have identified two possible ways adopted by for-profit producer-owned organizations for avoiding the non-excludability. The first is tie-in transactions, by which a non-excludable good can be tied with the transaction of other goods free from the non-excludability difficulty. The other is indirect transaction via a third transacting party, which provides a route for circumventing the direct transaction troubled by non-excludability

between the two sides. When the above contractual arrangements are feasible, for-profit producer-owned organizations may preserve their advantages as previously mentioned.

When the contractual arrangements of tie-in transactions or indirect transactions via a third transacting party are not available, customer-owned organizations may provide the resolutions for the non-excludability problem. In the case of common pool resources, such organizations as community associations might succeed, depending on the homogeneity of the involved interests, in establishing agreed-upon rules for restoring exclusive rights to use and income. In the case of fire control, legislation of protecting service provider's income right could resolve the non-excludability problem for for-profit fire-control subscription business. For-profit producer-owned organizations in this case cannot survive without the above legislation, which has to be provided by the government, one form of customer-owned organizations. As in the case of establishing regulations aiming at transacting difficulties, if the proposed legislation of protecting providers' income rights greatly affects the established interests under other organizational arrangements, interest competition in the political process may not result in the legislation. The homogeneity of the involved interests again shows its crucial role in this case.

My empirical study in the ownership patterns of dams strongly supports most of the above theoretical conclusions. In the case of navigational dams/locks, investment specificity and monopolistic power as the primary transacting difficulties make the government ownership most likely. 1998-99 NID data supports this conclusion. Although the possibility of for-profit producer ownership with the aid of appropriate regulations is the direct theoretical implication, such possibility requires further investigation. In the case of flood-control dams, against which non-excludability is the major obstacle, for-profit producer ownership via tie-in transactions and ownership held by customer-owned organizations such as community associations and governments are the most feasible organizational

arrangements. In the case of dams for fish and wildlife conservation, nonprofit individuals and organizations show its significant presence, besides that of tie-in transactions and customer-owned organizations. The above testable hypotheses are some important implications derived from my theoretical foundation, which enables me to outline a whole picture for the ownership patterns of navigation, flood-control, and fish-wildlife conservation dams. Confirming evidences have been found in the empirical study for the theoretical foundation maintained in this dissertation.

Given my intended focus on the most general rules for the organizational patterns of public good provision, it is inevitable to neglect many details in those cases discussed in my dissertation. Especially, the omission of investigating the historical details of individual cases makes it difficult to analyze in depth the dynamic process of organizational arrangements. However, it is my belief that only in a dynamic analytical framework will we see more clearly how organizational efficiency, interest competition, and organizational formation are interrelated. This part will require more focused case studies, which are precluded from the research goals that I set for this dissertation. For further refining and extending my theoretical analysis, future research in this direction shall be necessary.

APPENDIX NID DATA DIRECTORY

Record
Assigned by TEC.

Dam Name
Official name of the dam. No abbreviations used unless a part of the official name. For dams that do not have an official name, the popular name is used.

Other Dam Names
Reservoir name or names in common use other than the official name of the dam. Names are separated with semi-colons. Leave blank if not applicable.

Dam Former Name
Any previous reservoir or dam name(s), if changed. Names are separated with semi-colons.

State or Federal Agency ID
Official State or Agency identification number for the dam.

NID ID
The official NID identification number for the dam, known formerly as the National ID. This is a required field, and must have an entry for each dam included in the NID. This field is used as the unique identifier for each dam record. The first two characters of the identity are the state two-letter abbreviation, based on the location of the dam. The last five characters of the identity are a unique number (AB######).

The NID ID is the Corps Identification Number assigned to each dam in the 1995-96 NID update, under the National Dam Inspection Program (P.L. 92-367). Once assigned, this number should be not changed. However, the following guidelines are provided for assignment of ID numbers for new dams. Each new dam will be assigned an NID ID number by the state or federal coordinator. NID ID numbers will not be reused. If a dam is retired or is otherwise not longer in existence, that ID number is retired. The state coordinator is responsible for assigning ID numbers for all dams, regardless of ownership. The numbers may not necessarily be continuous, because of a previously established scheme which assigned certain number ranges to federal agencies. Continued use of this numbering scheme for new dams is at the discretion of the state coordinator. Please contact ASDSO or USACE Dam Safety Team for further information on the process of assigning NID ID numbers or if an alternative number sequence is necessary to meet the needs of the state.

Longitude
Longitude at dam centerline as a single value in decimal degrees.

Latitude

Latitude at dam centerline as a single value in decimal degrees.

Section, Township, Range Location

Dam location in terms of Section, Township, and Range. Meridian location is included if it is needed to locate the dam. (Optional field)

County

Name of the county in which the dam is located.

River or Stream

Official name of the river or stream on which the dam is built. If the stream is unnamed, it is identified as a tributary ("TR") to the named river. If the dam is located offstream, the name of the river or stream is entered plus "-OS" or "OFFSTREAM".

Nearest City/Town

Name of the nearest city, town, or village that is most likely to be affected by floods resulting from the failure of the dam.

Distance to Nearest City/Town

Distance from the dam to the nearest affected City/Town/Village, to the nearest mile (and tenth if appropriate).

Owner Name

Name of the owner of the dam.

Owner Type

Code indicating owner type:

F for Federal;
S for State;
L for Local Government;
U for Public Utility;
P for Private.

Dam Designer – New field

Name of the principal firm(s) or agency accomplishing design of dam and major appurtenant operating features, and major modifications. The original designer is listed first then modification designers (if applicable). The names are separated with semi-colons.

Private Dam On Federal Property

Code indicating whether the dam is a private dam located on federal property:

Y for Yes;
N for No.

Dam Type

Code indicating the type of dam (in order of importance): RE for Earth;
ER for Rockfill;

PG for Gravity;
CB for Buttress;
VA for Arch;
MV for Multi-Arch;
CN for Concrete;
MS for Masonry;
ST for Stone;
TC for Timber Crib;
OT for Other.

Codes are concatenated if the dam is a combination of several types. For example, the entry CNCB would indicate a concrete buttress dam type.

Core – New field

Code indicating the position, type of watertight member and certainty.

Position:
F for upstream facing;
H for homogenous dam;
I for core;
X for unlisted/unknown;

Type:
A for bituminous concrete;
C for concrete;
E for earth;
M for metal;
P for plastic;
X for unlisted/unknown;

Certainty:
K for known;
Z for estimated;

Foundation – New field

Code for the material upon which dam is founded, and certainty.

Foundation:
R for rock;
RS for rock and soil;
S for soil;
U for unlisted/unknown.

Certainty:
K for known;
Z for estimated.

Purposes

Codes indicating the purposes for which the reservoir is used:
I for Irrigation;
H for Hydroelectric;

C for Flood Control and Storm Water Management;
N for Navigation;
S for Water Supply;
R for Recreation;
P for Fire Protection, Stock, Or Small Farm Pond;
F for Fish and Wildlife Pond;
D for Debris Control;
T for Tailings;
O for Other.

The order indicates the relative decreasing importance of the purpose. Codes are concatenated if the dam has multiple purposes. For example, SCR would indicate the primary purposes, Water Supply and Flood Control and Storm Water Management, followed by Recreation.

Year Completed

Year when the original main dam structure was completed, optionally followed by code ("E") to indicate an estimated date. If unknown, and reasonable estimate is unavailable, "0000" will be used.

Year Modified – New field

Year (four digit) when major modifications or rehabilitation of dam or major control structures were completed. Major modifications are defined as a structural, foundation, or mechanical construction activity which significantly restores the project to original condition; changes the project's operation; capacity or structural characteristics (e.g. spillway or seismic modification); or increases the longevity, stability, or safety of the dam and appurtenant structures. Entries should be followed by one of more of the following codes indicating type of modification:

S for structural;
F for foundation;
M for mechanical;
E for seismic;
H for hydraulic;
O for other.

Up to ten modifications can be entered, separated by semicolons.

Dam Length

Length of the dam, in feet, which is defined as the length along the top of the dam. This length also includes the spillway, powerplant, navigation lock, fish pass, etc., where these form part of the length of the dam. If detached from the dam, these structures should not be included.

*** Because the "height of dam" definition used by each of the participating State and Federal agencies varies, three different height fields are provided in the NID database. Each agency is requested to enter values for the height field item(s) that most closely correspond to the height of the dam definition(s) used by the agency. Height field items #24-26 that do not correspond to agency data maybe left blank***

Dam Height

Height of the dam, in feet to the nearest foot, which is defined as the vertical distance between the lowest point on the crest of the dam and the lowest point in the original streambed.

Structural Height

Structural height of the dam, in feet to the nearest foot, which is defined as the vertical distance from the lowest point of the excavated foundation to the top of the dam.

Hydraulic Height

Hydraulic height of the dam, in feet to the nearest foot, which is defined as the vertical difference between the maximum design water level and the lowest point in the original streambed.

NID Height

A calculated field based on the maximum value of field items #25 Dam Height, #26 Structural Height, and #27 Hydraulic Height, providing a single height value to facilitate database queries.

Maximum Discharge

Number of cubic feet per second (cu ft/sec) which the spillway is capable of discharging when the reservoir is at its maximum designed water surface elevation.

Maximum Storage

Maximum storage, in acre-feet, which is defined as the total storage space in a reservoir below the maximum attainable water surface elevation, including any surcharge storage.

Normal Storage

Normal storage, in acre-feet, which is defined as the total storage space in a reservoir below the normal retention level, including dead and inactive storage and excluding any flood control or surcharge storage.

NID Storage

A calculated field based on the maximum value of field items #30 Maximum Storage and #31 Normal storage, providing a single storage value to facilitate database queries.

Surface Area

Surface area, in acres, of the impoundment at its normal retention level.

Drainage Area

Drainage area of the dam, in square miles, which is defined as the area that drains to a particular point (in this case, the dam) on a river or stream.

Downstream Hazard Potential

Code indicating the potential hazard to the downstream area resulting from failure or misoperation of the dam or facilities:

L for Low;

S for Significant;
H for High.

Definitions, as accepted by the Interagency Committee on Dam Safety, are as follows:

1. LOW HAZARD POTENTIAL
   Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

2. SIGNIFICANT HAZARD POTENTIAL
   Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

3. HIGH HAZARD POTENTIAL
   Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

Emergency Action Plan

Code, indicating whether the dam has an Emergency Action Plan (EAP) developed by the dam owner. An EAP is defined as a plan of action to be taken to reduce the potential for property damage and loss of life in an area affected by a dam failure or large flood.

Y for Yes;
N for No;
NR for Not Required by submitting agency.

Inspection Date

Date of the most recent inspection of the dam prior to the transmittal of the data by the submitting agency. Date fields require day, month and year information, and various alphanumeric or numeric combinations are used.

Inspection Frequency – New Field

Scheduled frequency interval for periodic inspections, in years. NOTE: Replacement for "Phase I Inspection" field.

State Regulated Dam – New Field

Code indicating whether the dam is "State Regulated" under the National Dam Safety Program Act:

Y for Yes;
N for No.

A "State Regulated Dam" is defined as a dam meeting the NID criteria for which the State executes one or more of the following general responsibilities: (a) Inspection; (b) Enforcement; or (c) Permitting.

State Regulatory Agency

Name of the primary state agency with regulatory or approval authority over the dam.

NOTE: Following four fields are optional submissions for states

Spillway Types

Code that describes the type of spillway:

C for Controlled;
U for Uncontrolled;
N for None.

Spillway Width

Width of the spillway, to the nearest foot, available for discharge when the reservoir is at its maximum designed water surface elevation.

Outlet Gates – New Field

Code(s) that describe the type of spillway and controlled outlet gates, if any:

X for None;
U for Uncontrolled;
T for Tainter (radial);
L for Vertical Lift;
R for Roller;
B for Bascule;
D for Drum;
N for Needle;
F for Flap;
S for Slide (sluice gate);
V for Valve;
O for Other controlled.

Enter up to five types in decreasing size order, separated by semicolons, followed by number of gates.

Volume of Dam

Total number of cubic yards occupied by the materials used in the dam structure. Portions of powerhouse, locks, and spillways are included only if they are an integral part of the dam and required for structural stability.

*** NOTE: The remaining fields are federal submissions only ***

Number of Locks
Number of existing navigation locks for the project.

Length of Locks
Length of the primary navigation lock to the nearest foot.

Lock Width
Width of the primary navigation lock to the nearest foot.

*** NOTE: See Table below for required codes for the following fields***

Federal Agency Involvement in Funding
Code identifying which federal agency was involved in funding of the dam. Codes are concatenated if several agencies were involved.

Federal Agency Involvement in Design
Code identifying which federal agency was involved in the design of the dam. Codes are concatenated if several agencies were involved.

Federal Agency Involvement in Construction
Code identifying which federal agency was involved in the construction of the dam. Codes are concatenated if several agencies were involved.

Federal Agency Involvement in Regulatory
Code identifying which federal agency is involved in the regulation of the dam. Codes are concatenated if several agencies are involved.

Federal Agency Involvement in Inspection
Code identifying which federal agency is involved in the inspection of the dam. Codes are concatenated if several agencies are involved.

Federal Agency Involvement in Operation
Code identifying which federal agency is involved in the operation of the dam. Codes are concatenated if several agencies are involved.

Federal Agency Owner
Code identifying which federal agency partly or wholly owns the dam. Codes are concatenated if several owners are involved.

Federal Agency Involvement in Other
Code identifying which federal agency is involved in other aspects of the dam. Codes are concatenated if several owners are involved.

Source Agency

Code identifying the federal or state source agency that has provided the field data on the dam. The code used for a state source agency is the two letter abbreviation for the state; the code used for a federal source agency is the Federal Agency Code defined in the table below.

State

The two letter abbreviation for the state in which the dam is located. A calculated field based on the field item #6 NIDID.

FEDERAL AGENCY CODE TABLE	
Federal Agency Name	Federal Agency Code
Department of Agriculture:	
Natural Resources Conservation Serv Formerly Soil Conservation Serv (SCS)	USDA NRCS
Forest Service	USDA FS
Rural Housing Service Formerly Farmers Home Loan	USDA RHS
Department of Defense:	
US Army Corps of Engineers	CE
US Army	DOD USA
US Navy	DOD USN
US Air Force	DOD USAF
Department of Interior:	
Bureau of Indian Affairs	DOI BIA
Bureau of Land Management	DOI BLM
Fish and Wildlife Service	DOI FWS
Geological Survey	DOI GS
Bureau of Reclamation	DOI BR
National Park Service	DOI NPS
Department of Labor:	
Mine Safety and Health Administration	DOL MSHA
Department of State:	
International Boundary and Water Commission	IBWC
Department of Energy:	
Federal Energy Regulatory Commission	DOE FERC
Nuclear Regulatory Commission	US NRC
Tennessee Valley Authority	TVA

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