# Measuring Capacity Indicators of Civil Society for Environmental Management in Beijing Based on an Attitudinal Survey

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## Abstract

There exist some limitations when applying macro-level data to measure social capacity for environmental management. Especially, such macro-level data cannot properly measure the quality of environmental management. This paper attempts to measure the capacity indicators of civil society based on an attitudinal survey, which is designed with the help of the concepts of *Good Urban Governance* and *Service Quality*. A case study is conducted in Beijing and finds that the citizens perceive that the capacities of government, firms and civil society interact with each other. It is also confirmed that capacity of civil capacity has the largest influence on people's health, livability, and ecosystems.

**Key Words:** attitudinal survey, capacity indicator, civil society, quality of environmental management, structural equation model

## 1. Introduction

Successful environmental management usually needs to involve various actors during the policy making process. Different actors play differing roles and interact with each other from time to time, context to context, and country to country. Under such circumstances, social capacity for environmental management (SCEM) was proposed as a new concept to help effective policy decisions (Matsuoka and Kuchiki, 2003; Matsuoka et al. 2004).

Based on extensive reviews about previous research by Zhang et al. (2005b), Zhang et al. (2005a) redefined SCEM as the capacity that the whole society, composed of three social actors: government, firms and civil society, makes use of available capital assets (including natural capital, physical capital, financial capital, human capital, and social capital) to deal with environmental problems toward sustainable states through the learning process under the influence of actors' co-existence, inter-actor interactions and future uncertainty. In this definition, *learning process* suggests the importance of reference point(s) or benchmark(s) in the measurement of social capacity and the necessity of developing dynamic process model to derive the capacity indicators. *Sustainable states* are the policy goals that are required to link with the measurement of capacity. The three actors cover all the stakeholders involved in environmental management. Use of *capital asset*, consideration of *actors' co-existence* and *interactions among three actors* implies that to develop the capacity indicators, one needs to apply systematic approaches to incorporate all the influential factors. It should be noted that capacity of each actor also could be defined in the similar way. Such definition is different from the original definition of SCEM by Matsuoka and Kuchiki (2003), and Matsuoka et al. (2004). This new definition not only defines the social capacity in a systematic manner, but also describes how to measure the social capacity. Concretely speaking, it suggests to measure the social capacity based on the linkages with environmental states. In other words, it argues that indicators would not be useful without such linkage, because indicators should work for policy making.

In the context of urban air quality management, considering data availability in developing countries, Zhang et al. (2005a) proposed a structural equation modeling approach to derive social capacity indicators by combining a city-level data obtained from "Millennium Cities Database" (Vivier, 2001) and a nation-level data collected from "Environmental Sustainability Index" (WEF, 2001). The city-level data was used to evaluate sustainability of urban development including land use, transport and environmental factors. The nation-level data was used to measure social capacity. Zhang et al. confirmed the applicability of structural equation model in evaluating sustainability and measuring social capacity. However, they also found some limitations when applying such macro-level data. For example, Zhang et al. clarified that enhancing government capacity would contribute to the reduction of environmental emissions, however, capacity of civil society and capacity of firms worked in an opposite way. This seems not intuitive. Furthermore, we have to point out that another problem is that using such macro-level data cannot properly measure the quality of environmental management, because such data only tell people what happened, rather than how happened.

To overcome the above-mentioned problems, this paper attempts to propose a new method of developing social capacity indicators based on an attitudinal survey data with respect to government, firms and civil society. The survey questionnaires were designed based on the concept of TUGI framework for measuring good urban governance (TUGI, 2003) and the concept of service quality (Parasuraman et al. 1985) widely used in marketing research. We conducted the survey in Beijing in October 2004.

Although this is still an on-going research, we report some research findings using the data collected from the citizens.

This paper is organized as follows. Section 2 describes the concepts of good governance and service quality, which are essential to the newly proposed methodology of measuring social capacity indicators. Section 3 explains the newly proposed methodology about how to capture the cause-effect relationships existing in the measurement of capacity. Following that, the section 4 shows the model estimation results and examines the applicability of proposed methodology. Finally, this study is summarized in Section 5.

## 2. Good Urban Governance and Service Quality

As mentioned in the previous section, using macro-level data might result in some unintuitive and misleading policy decisions. This might be caused by the fact that such macro-level data cannot properly capture quality of environmental management. For example, expenditure for research and development is usually regarded as an important indicator to measure social capacity. However, this data only show the amount of money invested in the research and development, but it does not tell us how the money was expended and how effective such investment is. Because of its intangibility, measurement of such quality of environmental management has to reply on some feedbacks (e.g., opinions, attitudes and sub-jective evaluations) from various actors. Accordingly, we propose to measure the social capacity incor-porating the influence of management quality based on the concept of *service quality*, which has been widely applied in marketing research. We further adopt the concept of *good urban governance* to identi-fy the required elements to measure the quality of environmental management.

### 2.1. Concept of service quality

Based on reviews about existing research, we can summarize the essential elements about the defini-tion of service quality in Figure 1. It is argued that service quality depends on the gap between expecta-tion (importance) and performance. The former is affected by both attitude and experience, and the latter is mainly influenced by experience. Furthermore, it is expected that experience and attitude interact with each other, reflecting the influence of needs/wants. All these elements influence people's quality of life (QOL). Of course, such mechanism will be different according to the context of evaluation. Kozak (2001) gives more detailed explanations about the definition of service quality.

To properly measure such quality of service, Parasuraman et al. (1985) propose a gap model in the context of consumer analysis. He argues that there exist five major gaps that need to be incorporated in the measurement of service quality (see Figure 2).

*Gap 1*: gap between consumer expectations and management perceptions of those expectations

*Gap 2*: gap between management perceptions of consumer expectations and firms' service quality specifications

*Gap 3*: gap between service quality specifications and actual service delivery

*Gap 4*: gap between actual service delivery and external communications about the service

*Gap 5*: gap between expected service and perceived service

One can see that the gap model takes into account the essential factors across the whole process of service provision. Such considerations are also required in environmental management.
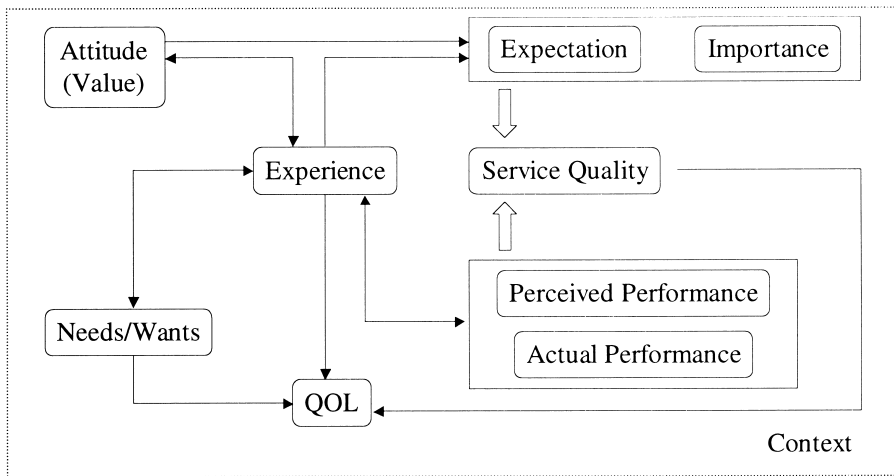
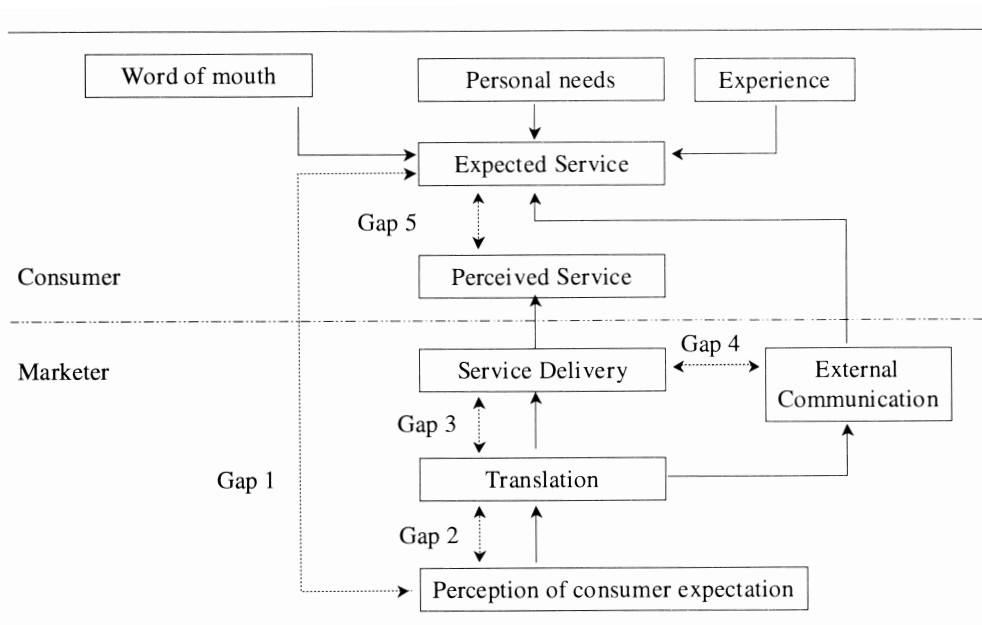**Figure 1.** Conceptual definition of service quality.



**Figure 2.** Conceptual description of gap model (Source: Parasuraman et al. 1985).

## 2.2. Concept of good urban governance

Governance is the process through which diverse elements in a society wield power and authority affect and enact policies and decision concerning public life and economic and social development. Governance is carried out by the state, as well as the private sector and civil society (Ehler, 2003). The concept of "good governance" has become a fashionable term in development discussions over the past decade. The United Nations Development Programme (UNDP) has defined governance as the exercise of political, economic and administrative authority in the management of a country's affairs at all levels. It comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences".

TUGI (2003) argues that four aspects of the above definition are important to underline with respect to good urban governance. First, governance is conceptually broader than government. It recognizes that power exists inside and outside the formal authority and institutions of government. At the local level, these groups can include: central and local governments, non-governmental organizations (NGOs), community-based organizations (CBOs), and the private sector. Second, governance is broader than management, which tends to focus on the implementation and administration functions of government. This implies that good urban governance is not only concerned with the management function that a local government performs but also about the environment in which management decisions are taken and implemented. The third point emphasizes governance process. This recognizes that decisions are made based on complex relationships between many actors with different priorities. Finally, governance is a neutral concept. The actors, mechanisms, processes and institutions can produce positive or negative results. TUGI (2003) further suggests to measure the indicators about good urban governance based on the framework shown in Figure 1, where five types of indicators are identified.
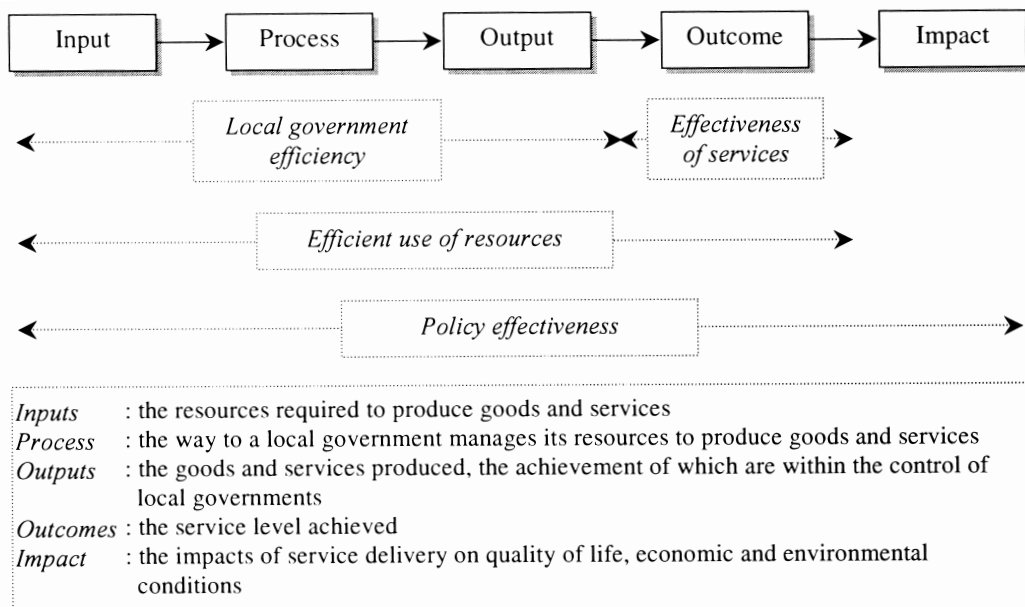


**Figure 3.** Indicator framework of The Urban Governance Initiative (Source: TUGI, 2003).

1) Input indicators measure the resources required to produce outputs, and the institutional environment in which the organization functions. These include such things as budget allocations, human resources, time required to produce outputs and institutional constraints.

2) Process indicators include the actions necessary within an organization to achieve the results. These can include the quality of administrative systems, procedures, policies and plans.

3) Output indicators show the externally visible results of the inputs and processes. These include goods and services that satisfy citizen needs, for example, water stand-pipes installed, information counters, number of permits processed, etc.

4) Outcome indicators measure the long-term goals or benefits derived from a process, usually in the form of satisfied needs or changes in behavior.

5) Impact indicators measure the impact of service delivery on the Quality of Life, Economic and Environmental Conditions.

The core characteristics of the TUGI framework are participation, rule of law, transparency, responsiveness, consensus orientation, equity, effectiveness and efficiency, accountability, and strategic vision. These characteristics are further described in Table 1.

As a methodology of measuring social capacity for environmental management, here, we apply the gap model, where "service" is interpreted as "environmental management", and "consumer" as "civil society" and "marketer" as firms and government. To embody the concept of gap, we adopt the nine core characteristics of TUGI framework shown in Table 1. Concretely speaking, we designed three types of questionnaires with respect to government sectors, firms and civil society, reflecting the essential elements in both the TUGI framework and the gap model.

As reviewed by Polidano (2000), there exist several attempts to measure the quality of governance. Notable examples include:

1) Transparency International's Corruption Perception Index, which attempts to gauge the extent of corruption in some 50 countries on the basis of surveys;

2) the world competitiveness rankings produced by the International Institute for Management Development (IMD, various years): these rate the "competitiveness" of nearly 50 countries on the basis of various indicators, including several relating to the quality of government;

3) the World Bank's 1997 World Development Report, which develops an index of state "credibility" for 70 countries covering various aspects of governance, such as judicial arbitrariness and political stability;

4) an ongoing initiative by the OECD in collaboration with the UN and the World Bank to construct indicators of development progress, including "participatory development and good governance";

5) commercial assessments of investment risk, which normally incorporate some indicators of political stability, quality of governance, and the market-friendliness of public policy.

Polidano (2000) further argues that the quality of governance might include 1) transparency (the ability of government to communicate its intentions), 2) public service (exposure to political interference), 3) bureaucracy (the extent to which red tape hinders business development), 4) government decisions (effectiveness of implementation), 5) customs administration (efficiency of customs clearing procedures) and 6) improper practices (prevalence of bribery and corruption). One can observe some factors that are also included in the TUGI framework. However, careful review observes that most of the existing research only focuses on the measurement of capacity at nation level. Accordingly, this study attempts to measure the capacity at the city level.

**Table 1.** Characteristics and norms of good governance in TUGI framework.

| Items | Characteristics and Norms |
|---|---|
| (1)<br>Participation | 1）Existing policies and programmes of the institution to encourage participation of the civil society in the development of a particular process<br>2）Relationship between the institution and stakeholders in the development of programmes/policy<br>3）Level of engagement of stakeholders in the development process<br>4）Level of awareness among the institutions staff on the importance of civil society participation in the development process<br>5）Gender sensitiveness in the participation process<br>6）Policies and programmes of the institution to encourage the participation of all stakeholders irrespective of their age, sex, language, economic condition, and religion<br>7）Sensitivity of the institution towards the importance of participation in general and from within a gender perspective in particular |
| (2)<br>Rule of law | 1）Existence and adequacy of the rules and regulations related to partnership with stakeholders<br>2）Fair and impartial enforcement of the existing rules and regulations in dealing with the stakeholders<br>3）To what extent the concerned parties (governments, stakeholders and the institution) adhere to the rules and regulations<br>4）Concern shown by the institution to take action against parties for violating rules and regulations |
| (3)<br>Transparency | 1）Level of transparency on the allocated budget and procedures for partnership with stakeholders<br>2）Access to information and processes for stakeholders to participate in the development process<br>3）Transparency on selecting stakeholders for partnerships<br>4）Transparency in assigning contract/work to stakeholders |
| (4)<br>Responsiveness | 5）Mechanism to ascertain the capacities of the various stakeholders and enter upon partnerships or involve accordingly<br>6）Ease of access for stakeholders involved in a programme or policy decision to work with the institution<br>7）Opportunities for stakeholders to take active part in the development process<br>8）Accommodating various categories and sizes of stakeholders<br>9）Gender sensitiveness of the institution in dealing with stakeholders |
| (5)<br>Consensus<br>orientation | 1）Practice reaching stakeholder consensus in major, important and strategic decisions<br>2）Institutional mechanisms to consult stakeholders<br>3）Gender sensitiveness in consensus orientation<br>4）Involvement of the key stakeholders in decision-making processes.<br>5）Execution of the joint decisions |
| (6)<br>Equity | 1）Institutional priority of resource investment to mobilize stakeholders and work in partnership and collaboration with them.<br>2）Opportunity for stakeholders of all categories to contribute and work freely.<br>3）Concern shown by stakeholders to respect and network among each other irrespective of their size and capacity<br>4）Extent of gender sensitiveness in mobilizing and working in partnership with stakeholders<br>5）How the institution deals with stakeholders of various categories including CBOs |

**Table 1.** Continued

| Items | Characteristics and Norms |
|---|---|
| (7) Effectiveness and efficiency | 1）Extent of mobilization of involvement of stakeholders for the development of a programme or policy.<br>2）Situation of the partnership and collaboration between the institution and the stakeholders.<br>3）Networking and collaboration among stakeholders<br>4）Extent of mobilization of the resources from the stakeholders<br>5）Cost effectiveness in the activities undertaken by stakeholders |
| (8) Accountability | 1）To what extent does the institution realize they are accountable for what they do.<br>2）To what extent do the stakeholders realize they are accountable for what they do.<br>3）To what extent the grievances and complains are entertained by the institution or overarching authority<br>4）What legal provisions are exist to compensate for negligent conduct<br>5）Examples of demonstrating accountability by the institution |
| (9) Strategic vision | 1）Availability of long-term or mid term programme and policy to mobilize and work in collaboration with stakeholders.<br>2）Reflection of the partnership programme with the stakeholders in the annual development programme and budget of the institution.<br>3）Availability of statistical information or profile of stakeholders involved<br>4）Regular updating of the information on stakeholders<br>5）Evaluation of the performance of the stakeholders |

Source: TUGI (2003)

## 3. Using a Structural Equation Model to Measure Social Capacity in the DPSIR Framework

According to OECD (1999) and VRDC (2001), in the DPSIR (Driving forces, Pressure, State, Impact and Response) framework (see Figure 4), social and economic developments exert *pressure* (*P*) on the environment and, as a consequence, the *state* (*S*) of the environment changes, such as the provision of adequate conditions for health, resources availability and biodiversity. Finally, this leads to *impacts* (*I*) on human health, ecosystems and materials that may elicit a societal *response* (*R*) that feed back on the *driving* forces (*D*), or on the *state* (*S*) or *impacts* (*I*) directly, through adaptation or curative action.

Concretely speaking, indicators for *driving forces* describe the social, demographic and economic developments in societies and the corresponding changes in life styles, overall levels of consumption and production patterns. Primary *driving forces* are population growth and developments in the needs and activities of individuals. These primary *driving forces* provoke changes in the overall levels of production and consumption. Through these changes in production and consumption, the *driving forces* exert pressure on the environment.

*Pressure* indicators describe developments in release of substances (emissions), physical and biological agents, the use of resources and the use of land. The *pressures* exerted by society are transported and transformed in a variety of natural processes to manifest themselves in changes in environmental conditions. Examples of *pressure* indicators are $CO_2$-emissions per sector, the use of rock, gravel and sand for construction and the amount of land used for roads.

*State* indicators give a description of the quantity and quality of physical phenomena (such as temper-
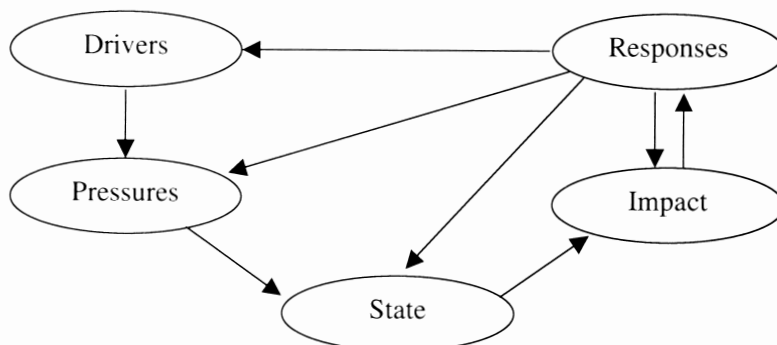
**Figure 4.** The DPSIR framework for reporting on environmental issues (Source: OECD, 1999; VRDC, 2001).

ature), biological phenomena (such as fish stocks) and chemical phenomena (such as atmospheric $CO_2$-concentrations) in a certain area. *State* indicators may, for instance, describe the forest and wildlife resources present, the concentration of phosphorous and sulphur in lakes, or the level of noise in the neighborhood of airports.

Due to *pressure* on the environment, the *state* of the environment changes. These changes then have *impacts* on the social and economic functions on the environment, such as the provision of adequate conditions for health, resources availability and biodiversity. *Impact* indicators are used to describe these impacts. *Impacts* occur in a certain sequence: air pollution may cause global warming (primary effect), which may in turn cause an increase in temperature (secondary effect), which may provoke a rise of sea level (tertiary impact), which could result in the loss of biodiversity.

*Response* indicators refer to responses by groups (and individuals) in society, as well as government attempts to prevent, compensate, ameliorate or adapt to changes in the state of the environment. Some societal *responses* may be regarded as negative driving forces, since they aim at redirecting prevailing trends in consumption and production patterns. Other *responses* aim at raising the efficiency of products and processes, through stimulating the development and penetration of clean technologies. Examples of *response* indicators are the relative amount of cars with catalytic converters and recycling rates of domestic waste. An often-used overall *response* indicator is an indicator describing environmental expenditures.

Based on this DPSIR framework, many international organizations have developed various indicators for the purpose of environmental management (Niemeijer, 2002). In order to meet this information needed for environmental management, indicators should reflect all elements of the causal chain that links human activities to their ultimate environmental impacts and the societal responses to these impacts. In this sense, the DPSIR framework is useful in describing the relationships between the origins and consequences of environmental problems. However, this framework is very conceptual and does not tell people how to measure these relationships.

In this paper, we attempt to apply a structural equation modeling approach to capture the complex cause-effect relationships in the DPSIR framework. Structural equation model is a set of simultaneous equations and has been proven useful in solving many substantive research problems in social and behavioral sciences. Such models have been used in the study of macroeconomic policy formation, intergenerational occupational mobility, racial discrimination in employment, housing and earnings,

studies of antecedents and consequences of drug use, scholastic achievement, evaluation of social action programs, voting behavior, studies of genetic and cultural effects, factors in cognitive test performance, consumer behavior, and many other phenomena including transportation. Methodologically, the models play many roles, including simultaneous equation systems, linear causal analysis, path analysis, structural equation models, dependence analysis, and cross-legged panel correlation technique (Jöreskog and Sörbom, 1989). Structural equation model is used to specify the phenomenon under study in terms of putative cause-effect variables and their indicators. Following the descriptions by Jöreskog and Sörbom (1989), the full model structure can be summarized by the following three equations.

Structural Equation Model:

$$\eta = B\eta + \Gamma\xi + \zeta \tag{1}$$

Measurement Model for y:

$$y = \Lambda_y\eta + \varepsilon \tag{2}$$

Measurement Model for x:

$$x = \Lambda_x\xi + \delta \tag{3}$$

Here, $\eta' = (\eta_1, \eta_2, ..., \eta_m)$ and $\xi' = (\xi_1, \xi_2, ..., \xi_m)$ are latent dependent and independent variables, respectively. Vectors $\eta$ and $\xi$ are not observed, but instead $y' = (y_1, y_2, ..., y_p)$ and $x' = (x_1, x_2, ..., x_q)$ are observed dependent and independent variables. $\zeta$, $\varepsilon$, $\delta$ are the vectors of error terms, and $B$, $\Gamma$, $\Lambda_x$, $\Lambda_y$ are the unknown parameters.

Concretely speaking, the cause-effect relationships shown in Figure 4 will be quantitatively represented using equations (1)~(3).

## 4. Data

In this study, we attempt to examine the effectiveness of the above-proposed methodology in Beijing, which will be the host of the 2008 Olympic Game. It is known that China's large cities, including Beijing, are already among the worst polluted in the world. In the early 1990s, it was empirically confirmed that pollution levels exhibit an inverted-U-shaped curve with respect to per capita income (Selden and Song, 1995). According to this well-known environmental Kuznets curve (EKC) theory, pollution levels first rise as income rises, then fall as income continues to rise. However, it is not true that a developing country like China will have to ignore current environmental degradation to await some level of future economic development. Niu and Harris (1996) argue that low-income nations are able to learn the lesson of developed countries' faults in environmental protection for the purpose of seeking a balance between the environment and development. They further emphasize that China can use environmental protection technology of developed countries, which has been demonstrated to be effective in reducing pollution, and it can also use successful environmental management systems of developed countries. We also agree to this argument. To realize its modernization, nowadays, the gov-

ernmental authorities in China are very actively adopting the advanced management technology of developed countries. As discussed previously, *governance* is a neutral concept and it might contribute to better understand environmental management issues in China.

As the first step to measure social capacity in Beijing, here, we conduct a case study to measure the capacity of civil society. Following the definition of SCEM described at the beginning of this paper, we can define the capacity of civil society as the capacity that the civil society makes use of available capital assets to deal with environmental problems considering their impacts on the citizens' life through the learning process and recognizing the co-existence with other actors, interactions among actors and future uncertainty. We first designed an attitudinal questionnaire about urban air quality management in Beijing with respect to the citizens based on the definition of civil society, the concept of good urban governance, and the concept of service quality. Then we conducted the survey in September and October 2004. The questionnaire includes the following information:

1) Personal attributes (age, gender, occupation, academic background, and commuting behavior),
2) Access frequency of information sources to learn about environmental knowledge,
3) Respondents' perceived performance of, future expectation about transportation systems and ecosystems, and perceived change in these two systems during the recent 5 years,
4) Respondents' perceived impact of air pollution and its countermeasures on people's health, livability, ecosystems and economic growth, and
5) Measurement of capacities of civil society, firms, Beijing City and the Central Government: Capacity is defined based on the nine core characteristics in the TUGI framework, and its quality aspects are captured using the concept of service quality. In total, there are 49 items related to the nine core characteristics. One can see from Table 3 that these nine core characteristics reflect the essential parts of the whole management process. To reduce respondents' burden, we regrouped all these 49 items into 31 items, which were further divided into three major categories of citizens, firms and government. Respondents were asked to report their perceived performances of and future expectations on each item based on 5-scale rating method, where the lowest evaluation is rated as 1 and the highest evaluation as 5.

In this study, we adopted the following three items to measure the capacity of civil society.

(1) Citizens show interests in air pollution issues and have enough knowledge.
(2) Citizens know very well the laws, regulations, and rules related to the prevention of air pollution, enacted by the government authorities, and make full use of various means to actively participate in the decision-making process of reducing air pollution.
(3) Citizens obey the laws, regulations, and rules related to the prevention of air pollution, enacted by the government authorities.

The resultant total valid number of samples is 281. To evaluate the capacity for the whole Beijing City, these 281 samples are not enough. On the other hand, as shown in Figures 5, 6, and 7, nearly 60% of respondents are under 30 years old (Figure 5), about 80% have academic degrees from universities (47%) and graduate schools (31%) (Figure 6) and the respondents working at governmental sector occupy about 16%, 42% at private companies, and 42% from other civil society (Figure 7). Even though we do not have the relevant information of the whole population in Beijing at the time of survey, it is difficult to argue that the data shown in these three figures reflect the distributions in the population. Since in this study we are only interested in confirming the effectiveness of the proposed methodology, we adopted the 281 samples for the following analysis.
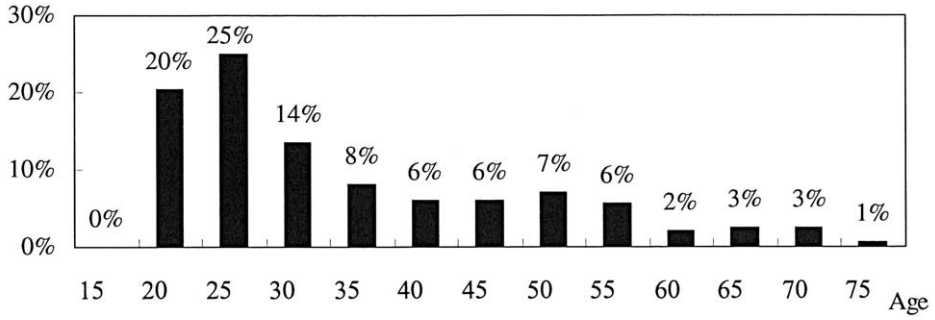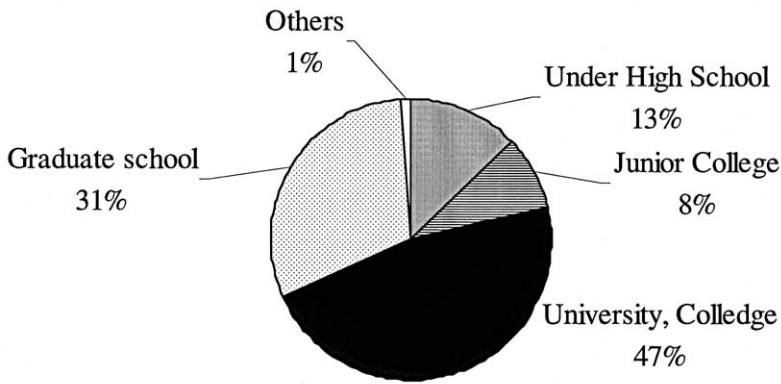
**Figure 5.** Distribution of age in the survey.
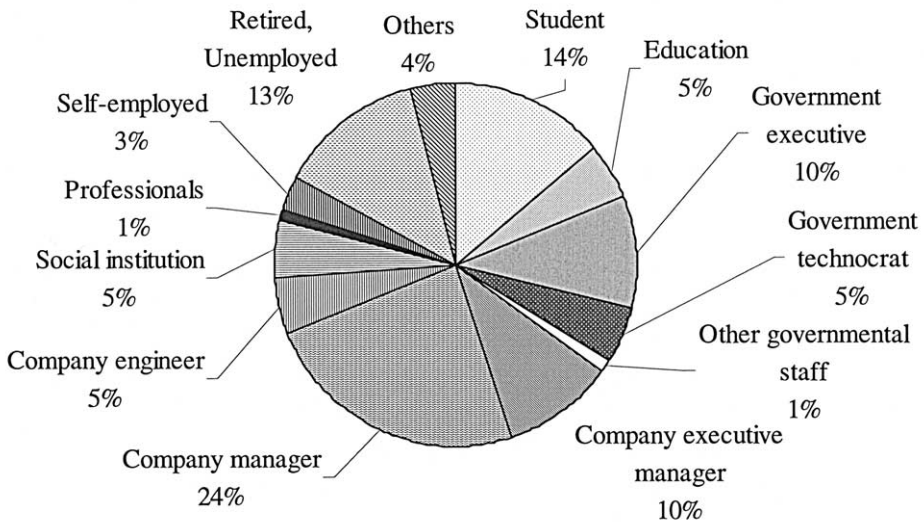


**Figure 6.** Distribution of academic background in the survey.



**Figure 7.** Distribution of occupations in the survey.

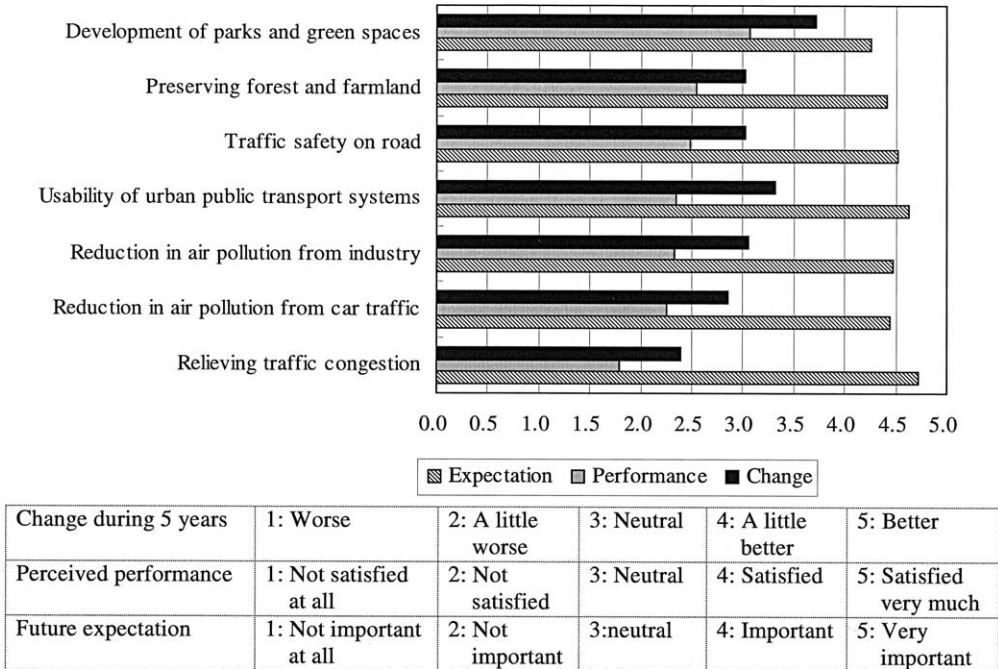| Change during 5 years | 1: Worse | 2: A little worse | 3: Neutral | 4: A little better | 5: Better |
|---|---|---|---|---|---|
| Perceived performance | 1: Not satisfied at all | 2: Not satisfied | 3: Neutral | 4: Satisfied | 5: Satisfied very much |
| Future expectation | 1: Not important at all | 2: Not important | 3:neutral | 4: Important | 5: Very important |

**Figure 8.** Evaluations of expectation, performance and change during the last 5 years in Beijing.

Figure 8 shows the citizens' expectations about, perceived performance of and perceived change in transportation systems and ecosystems in Beijing during the last 5 years. The lowest evaluation is observed with respect to the perceived performance related to traffic (traffic congestion and air pollution from car traffic). The performances of all items except "development of parks and green spaces" have not reached the satisfactory level (i.e., lower than 3). It is also found that especially, "development of parks and green spaces" and "usability of urban public transport systems" are changing toward better directions. In contrast, citizens in Beijing show the highest expectations about "relieving traffic conges-
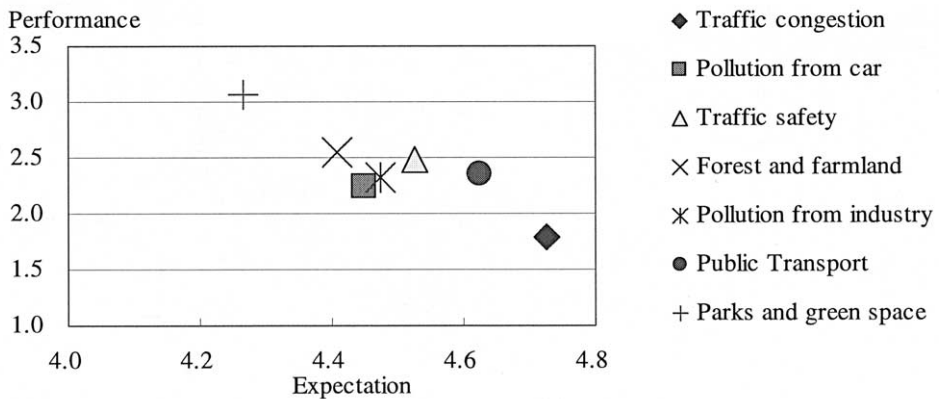


**Figure 9.** Perceived performance and future expectation.

**Table 2.** Perceived impacts of air pollution and its relieving policies.

| Evaluation Item | | Evaluation Result* |
|---|---|---|
| Impact of air pollution | Health | 4.66 |
| | Livability | 4.61 |
| | Ecosystems at neighbors | 4.55 |
| | Ecosystems at other areas | 4.34 |
| Impact of environmental preservation policies | Employment: "Unemployment rate may become higher due to the introduction of relevant policies" | 2.68 |
| | Production cost: "I would accept higher production cost in order to preserve environment" | 3.18 |
| | Car use & ownership: "I would accept the policies of reducing car use and ownership" | 3.65 |
| | Taxation: "I would accept higher tax to preserve environment" | 3.08 |
| | Economic growth: "I would accept lower economic growth to preserve environment" | 2.51 |

*Current impact level: 5.very high; 4.high; 3.neutral; 2.low; 1.very low

tion" followed by "usability of urban public transport systems". Observing the relationship between the perceived performance and expectation (Figure 9), it is obvious that the lower the perceived performance is, the higher the expectation is.

The survey also investigated the perceived current impacts of air pollution on people's health, livability, and ecosystems, as well as citizens' preferences about the relieving policies in the future. The results are shown in Table 2. On average, citizens show higher scores (between 4 and 5 points) of perceived current impacts, suggesting citizens' concerns about current situations. On the other hand, they do not think that the policies solving these problems could have considerably negative influences, implying that these policies could be accepted by most of the citizens.

Table 3 shows respondents' evaluations about current situations and future expectations related to capacity of civil society, perceived capacity of city and central government, and perceived capacity of logistic firms in Beijing. One can observe that citizens perceive large gaps between current situations and future expectations with respect to the items about public involvement, laws and rules, and firms' concerns about environmental issues. In contrast, citizens think that it is not so important to increase subsidies for R&D, to improve the public relation, to bring up experts, to make scientific decisions, and to enforce inspection and evaluation about air pollution, compared with other aspects.

## 5. Model Estimation and Evaluation of Social Capacity

To quantitatively represent the cause-effect relationships in the DPSIR framework, the following five latent variables are introduced: "capacity of civil society", "perceived capacity of government" and "perceived capacity of firms", "state or pressure", and "impact". Capacities of government and firms are

**Table 3.** Current situations and future expectations related to social capacity.

| Category | Items related governance indicators | | Perceived performance (A) | Future expectations (B) | Gap (B-A) |
|---|---|---|---|---|---|
| Capacity of Civil Society | Interest and knowledge | Citizens have more interest in and knowledge of environmental issues | 2.79 | 4.15 | 1.36 |
| | Involvement in policy making | Citizens participate in policy decisions | 2.44 | 4.04 | 1.60 |
| | Observance of law | Citizens strictly comply with the laws and rules | 2.64 | 4.19 | 1.55 |
| Capacity of government (national and local) perceived by citizens | Law systems | Governments establish laws and rules | 2.89 | 4.31 | 1.43 |
| | Criteria | Governments set strict criteria on environment | 2.73 | 4.28 | 1.56 |
| | Punishment | Governments set strict and fair penalty | 2.79 | 4.12 | 1.33 |
| | PI (Public Involvement) | Governments have PI scheme | 2.51 | 3.86 | 1.35 |
| | Budget for PI | Governments prepare enough fund for PI | 2.65 | 3.83 | 1.17 |
| | Policy Making based on PI | Governments make policy decisions collaborated with firms and citizens | 2.56 | 3.84 | 1.28 |
| | Long-term decision | Governments have long-term strategy for policy making | 2.84 | 4.19 | 1.34 |
| | Operation of law | Fair and strict operation of laws and rules | 2.60 | 4.20 | 1.60 |
| | Subsidy for R&D | Governments have enough funds for R&D | 2.79 | 3.87 | 1.08 |
| | Public relation | Governments open information to the public and enlighten citizens | 2.92 | 4.01 | 1.09 |
| | Education | Governments bring up experts on environment | 2.87 | 3.86 | 1.00 |
| | Scientific decisions | Governments utilize domestic and foreign experts | 2.93 | 3.78 | 0.85 |
| | Response to the Public | Response to complaints and requests from citizens | 2.60 | 3.96 | 1.36 |
| | Accountability | Accountability on policy decisions | 2.67 | 3.89 | 1.22 |
| | Inspection and evaluation | Regular monitoring of air pollution | 2.99 | 4.04 | 1.05 |
| | Mutual trust | Governments build mutual trust with citizens and firms | 2.78 | 3.93 | 1.15 |
| | Solution of conflict | Governments have schemes to solve various conflicts between governmental organizations | 2.70 | 3.92 | 1.22 |
| | Equity | Governments take into account equity of citizens and firms in practicing their policies | 2.74 | 3.93 | 1.19 |
| | Database | Governments actively develop database on environment | 2.82 | 3.92 | 1.10 |
| Capacity of firms perceived by citizens | Interest and knowledge | Firms have more interest in and knowledge of environmental issues | 2.60 | 4.16 | 1.56 |
| | Involvement in policy making | Firms participate in policy decisions | 2.58 | 4.18 | 1.60 |
| | Observance of law | Firms strictly comply with the laws and rules | 2.69 | 4.22 | 1.53 |
| | Response to the public | Response to complaints and requests from citizens | 2.35 | 3.95 | 1.60 |
| | Accountability | Accountability on their activities | 2.33 | 3.93 | 1.59 |
| | Inspection and evaluation | Regular monitoring of air pollution | 2.58 | 4.04 | 1.46 |
| | Database | Firms develop database on environment | 2.67 | 3.87 | 1.20 |
| | Education | Firms utilize experts on environment | 2.60 | 3.89 | 1.29 |
| | R&D | Firms bring up experts and enhance their technological levels | 2.61 | 3.88 | 1.27 |

named as "perceived capacity of government" and "perceived capacity of firms" because these capacities are the results evaluated by the citizens, rather than government and firms themselves.

As explained in Section 3, "state or pressure" is a latent variable representing the state of or pressure from transportation system, air pollution, and ecosystems. "Impact" refers to the impact on people's health, livability, and ecosystems.

In the questionnaire survey, the respondents were asked to report their subjective evaluations about current situations and future expectations. Here, only the research results based on the evaluations about current situations are described. The model estimation results are shown in Figure 10, where total sample size is 281. It is obvious that model accuracy indices (NFI, RFI, IFI and CFI) are relatively high and all the estimated parameters have expected signs. This suggests the validity of the proposed model structure.

### 5.1. Interactions among three actors

One can first observe strong correlations among three actors' capacities. Furthermore, all these correlations are statistically significant. This implies that at least the citizens perceive that the capacities of three actors interact with each other. If it is also true in the case of government and firms, this might mean that Beijing is close to self-management stage according to the definition by Matsuoka and Kuchiki (2003), and Matsuoka *et al* (2004). On the other hand, strong correlations among three actors' capacities might also suggest that we need to include some evaluation items about firms and government to measure the capacity of civil society. This needs to be further explored in the future.

### 5.2. Influence of each actor's capacity on "state or pressure" and "impact"

The standardized total effects obtained from the established structural equation model are shown in Table 4. Observing the total effects shown in Table 4, it is found that,

1) All the capacities have negative effects on "impact". This implies that enhancing social capacity composed of the three actors' capacities could improve the situations of people's health, livability, and ecosystems. Furthermore, "capacity of civil society" has the largest influence on "impact".

2) In contrast, only "capacity of civil society" has a negative effect on "state or pressure". This means that from the viewpoint of citizens, improvement in capacities of government and firms would worsen current situations of transport system, air pollution and ecosystems. This might imply that the citizens think that currently in Beijing, capacities of firms and government have not been given full play to solve current situations of transport system, air pollution and ecosystems. In addition, the citizens think that enhancing the "capacity of civil society" is the only way to improve current situations of transport system, air pollution and ecosystems.

3) It is found that "state or pressure" does negatively affect "impact", but the significant level is only 10%.

Concerning the effects on "impact", "capacity of civil society" has a negative direct effect on "impact". However, preliminary analysis results showed that the direct effects from "perceived capacity of government" and "perceived capacity of firms" were not significant.

With regard to the effects on "state or pressure", the "perceived capacities of government and firms" have positive values. In contrast, "capacity of civil society" has a negative effect. This might imply that the citizens think that current issues transport system, air pollution and ecosystems are caused by the government and firms, not themselves.
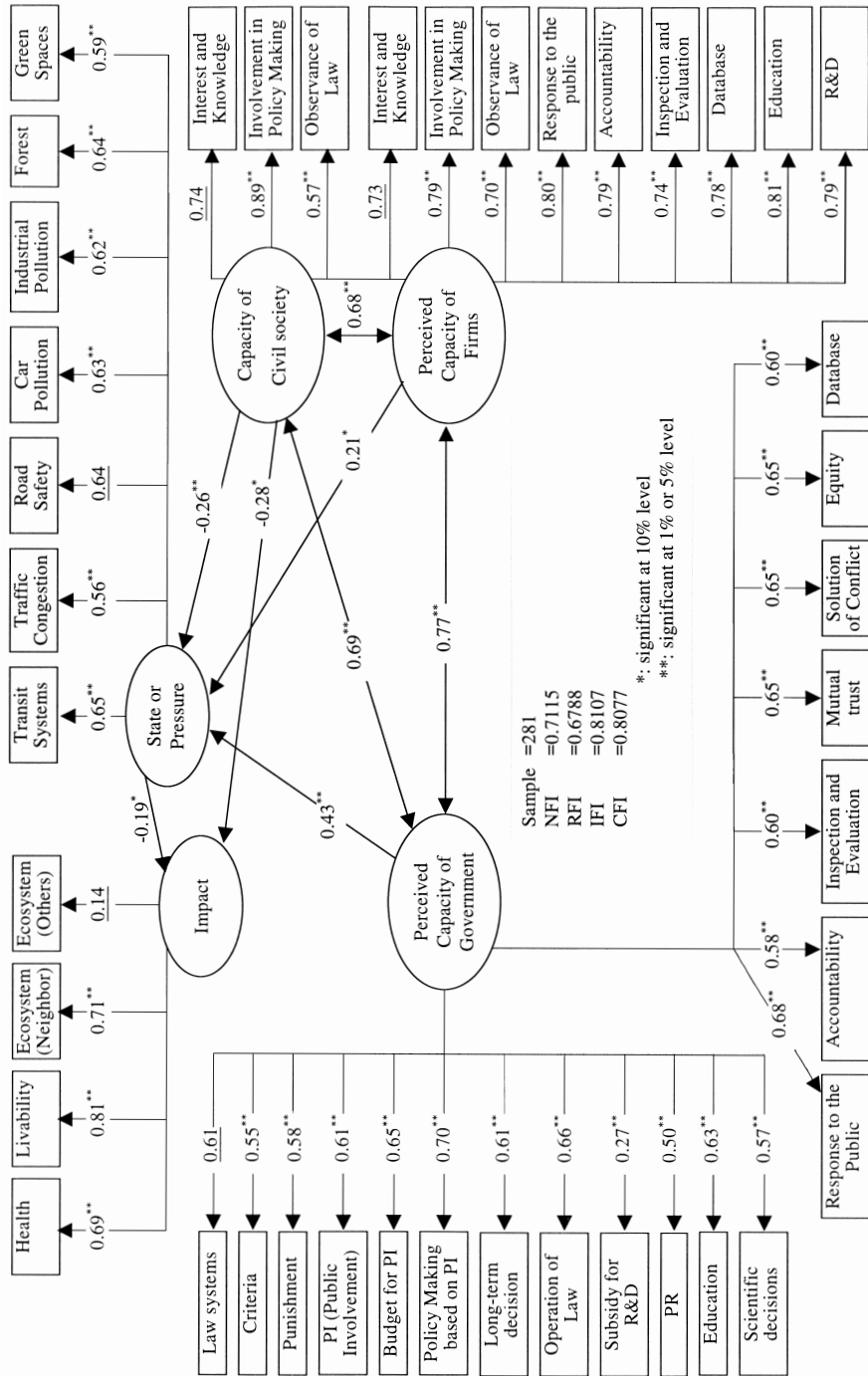
**Figure 10.** Estimation results of evaluation model of civil society.

**Table 4.** Standardized total effects.

| Item | Perceived capacity of government | Perceived capacity of firms | Capacity of civil society | State or Pressure | Impact |
|---|---|---|---|---|---|
| Impact | -0.0829 | -0.0411 | -0.2251 | -0.1922 | — |
| Ecosystem (Neighborhood) | -0.0589 | -0.0292 | -0.1600 | -0.1366 | 0.7107 |
| Ecosystem (Others) | -0.0115 | -0.0057 | -0.0313 | -0.0267 | 0.1389 |
| Health | -0.0570 | -0.0283 | -0.1548 | -0.1322 | 0.6879 |
| Livability | -0.0676 | -0.0335 | -0.1834 | -0.1566 | 0.8150 |
| State or Pressure | 0.4314 | 0.2140 | -0.2633 | — | — |
| Transit Systems | 0.2812 | 0.1395 | -0.1716 | 0.6517 | — |
| Traffic Congestion | 0.2432 | 0.1207 | -0.1484 | 0.5637 | — |
| Road Safety | 0.2777 | 0.1378 | -0.1695 | 0.6437 | — |
| Car Pollution | 0.2703 | 0.1341 | -0.1650 | 0.6266 | — |
| Industrial Pollution | 0.2659 | 0.1319 | -0.1623 | 0.6163 | — |
| Forest | 0.2744 | 0.1361 | -0.1674 | 0.6360 | — |
| Green Spaces | 0.2556 | 0.1268 | -0.1560 | 0.5924 | — |

## 5.3. Influential factors of each actor's capacity

It is found that all the introduced explanatory variables related to each capacity not only have expected signs, but also have statistically significant estimated parameters. This result supports the proposed design concepts about the questionnaire surveys measuring the social capacity.

It seems that if capacity of government is enhanced, the government might tend to emphasize the non-monetary polices rather than monetary policies such as increasing subsidies on R&D. Increase in capacity of civil society results in more active involvement in policy making process, comparing with other two elements, i.e., interest and knowledge, and observance of law. It is also confirmed that increase in capacity of firms leads to almost equal contribution to each element.

## 6. Conclusions and Future Research Issues

Most of existing studies have widely applied macro-level data to measure the capacities of actors involved in environmental management. However, such macro-level data cannot be used to properly capture the quality of environmental management. Under such circumstances, we suggest integrating the following three aspects in the same framework in this study.

1) Applying the concept of service quality to incorporate the influence of quality of environmental management in the measurement of capacity.
2) Adopting the DPSIR (Driving forces, Pressure, State, Impact and Response) framework to reflect the cause-effect relationships between the essential elements in environmental management.
3) Applying structural equation model to measure the capacity of each actor and its influences on environmental systems.

Using the data collected from the citizens in Beijing, we empirically confirmed the effectiveness of the proposed analysis framework in measuring the capacity of civil society for urban air quality management in transport sector. We also found that there exist strong correlations among three actors' capacities, and capacity of civil society has the largest influence on the impact of people's health, livability and ecosystems. The citizens also perceive that enhancing capacity of civil society is the only way to improve current situations of transport system, air pollution and ecosystems.

However, it should be noted that these conclusions are obtained based on the limited sample size and should be further examined using a large-scale survey data. It is also necessary to conduct the same questionnaire survey in other developing cities. Combining all these data together, we could incorporate some objective indicators related to each subjective evaluation term and consequently conduct some concrete policy analyses.

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