Report of the Working Group on Resource Accounting and Pricing Policy

1996-09-26

Since the last session of CCICED held in September of 1995,the Working Group on Resource Accounting and Pricing Policy has made further in-depth research and has finished the research report of group .At the same time, discussions and consultations have taken place concerning possible research topics in the next stage (1997-2001), and these ideas have been put forward for consideration at this session.

This report is made up of two parts:

1. final research achievements of the group ,and

2. possible research topics in next stage.

1. Final Research Achievements

This first part of the report will outline research achievements in the following project areas:

a. The Theoretical Framework of Natural Resources Pricing,

b. Case Study: Coal Resource Pricing,

c. Case Study: Water Resource Pricing,

d. Case Study: Forest Resource Pricing,

e. Case Study: Urban Transportation Pricing, and

f. Integrated Accounting Between Resources & the Economy.

a. The Theoretical Framework of Natural Resources Pricing.

It is common understanding around the world that rational pricing of natural resources should be set on the basis of sustainability. We use marginal opportunity cost(MOC)pricing theory, which is universally well known, as a basic theoretical framework.

This is to say that the price of a natural resource depends on its MOC, where the MOC represents the whole cost of a newly-harvested natural resource, inclusive of both direct and indirect costs.

MOC is made up of three parts:

(1)marginal production cost(MPC);

(2)marginal user cost(MUC);and

(3)marginal external cost(MEC)

Thus MOC=MPC+MUC+MEC, where:

(1)MPC is the cost, paid by producer, for natural resource harvesting. Theoretically, MPC includes exploration cost, harvest cost, cost for natural resource renewal and management cost of proven resources.

(2)MUC is the maximal net benefit from foregong ways for employment of the natural resource when the resource is made use of by someone in a certain way. MUC can also be seen as 'the cost of scarcity'. Scarcity of natural resource means that, in the first case, the market price of the 'scare' resource greatly exceeds the sum of its MPC(including normal profit)and its MEC. In the second case, the owner or producer of the 'scare' natural resource can gain extra profit. In the third, and long term, case increasing production will not weaken its price, and the extra profit margin will remain. It is stable extra profit relating to scarcity in kind that is MUC.

Generally speaking, non-renewable resources have scarcity in kind, so their price includes positive MUC. As long as the harvesting quantity is equal to, or less than, its growing quantity(such as forest and fish)or its replenishment quantity(such as water), the price of renewable resources does not include its MUC. But, by reason of over-harvesting and pollution, renewable resources are faced with both resource depletion and inter-temporal allocation of resource analogous to nonrenewable resources, and their prices include positive MUC too.

(3)MEC is the uncompensated loss of others from harvest and utilization of natural resources, mainly the loss from environmental deterioration. In other words, MUC is positive difference between environmental losses, which comes from harvest and utilization of natural resources, and the costs for pollution abatement and for compensating those affected by the pollution.

In practice, MEC has another meaning. It can represent the whole environmental loss caused by harvest and utilization of a natural resource, including the parts which have been accounted in the production cost(such as expenditures for pollution abatement, and for compensation). By the meaning, adjustment of items in both MPC and MEC are needed.

For different resources, different evaluation approaches are needed. In our research, case studies have been made on three representative resources:

(1)coal, a nonrenewable resource;

(2)water, a renewable non-biological resource; and

(3)forest, a renewable biological resource.

While urban transportation does not belong to natural resource classification, a theoretical framework for its MOC can also be adopted for research purposes. So both the Chinese and international sides of the working group agreed to undertake research on urban transportation as a sub-item, and some conclusions have been made.

b. Case Study: Coal Resource Pricing.

The Datong Coal Bureau of Shanxi Province was used for this case study. The MOC of raw pit coal was estimated, and relevant policy recommendations were put forward.

First, we estimated MUC of coal nationwide. Because coal can be transported easily and relatively cheaply, scarcity of coal resource is a macro-economic problem. With few exceptions, the coal sold with state-controlled in-plan pricing was almost non-existent by the end of 1994.So, the data throughout the year1994 was considered more reasonable. With their huge deficits, data of state-owned enterprises with independent accounting systems cannot reflect the MUC of the coal resource. So the working group used data from non-state-owned enterprises. In 1994,their ratio of pre-tax profits to industrial cost was 16.78%, Of this number, 12%, which is equal to the shadow discount rate, belongs to normal profit. The other 4.78% belongs to MUC. In 1994, the industrial cost of coal per ton was about100Yuan RMB, so the MUC in 1994 was about 5 Yuan RMB. There is an abundant geological reserve of coal in China. We assumed the MUC(constant price)would be unchanged. In 1991,the year we set as the base year of the study, the MUC was 3.5 Yuan RMB per ton of raw pit co al.

In our case study, the MEC of coal is the entire environmental loss caused by coal exploitation, including the parts which have been counted into the production cost (such as expenditures for pollution abatement, and for compensation), In 1991, the MEC of raw pit coal in the Datong coal Bureau was 3.68 Yuan/ton,with 1.02 Yuan/ ton into the financial account of the Bureau.

In our estimation, MPC includes:(1)actual financial costs for the production of raw pit coal in the Datong Coal Bureau; plus(2)costs for coal

exploration; minus(3)costs for redundant personnel in coal mine; plus(4)difference between market price and in-plan prices of some part of production cost; minus (5)environmental cost within financial account; plus(6)normal profit, In 1991,the MPC of Datong Coal Bureau was 64.78 Yuan /ton. Finally, with higher coal quality, we increase the price by 10.5 Yuan/ton as the quality difference.

Therefore, in 1991,the MOC of pit raw coal in Datong Coal in the Datong Coal Bureau was 82.46 Yuan/ton. But the actual market price of pit raw coal in the Datong Coal Bureau in 1991 was 48.57 Yuan/ton, which is equal to 58.7%of MOC, the reasonable price. Recently, coal prices in China have risen dramatically. To some extent, it is a correction for the previous irrational price of raw coal.

Other conclusions of our coal case study are as follows:

(1)Theoretically, the MUC of a natural resource is approximately equal to its marginal exploration cost. In reality, the marginal exploration cost of coal proven reserves (1.24 Yuan/ton, in 1991 constant price)is much lower than its MUC(3.5 Yuan/ ton).Low inputs restrict the development of coal exploration in China. There are abundant coal resources in China. The geological reserve is 5 trillion tons. Because of the slowness of coal exploration, by the end of 1995 industrial reserves in China were only 71.3 billion tons, and this industrial reserve can only satisfy 72 %of the need for new coal mine construction from the year 1996 to 2000.According our estimation. suppose the marginal exploration cost of coal, in constant price, increases 2% annually. Then, at least before the year 2010,it is feasible for the Chinese government to increase inputs into coal exploration, and make exploration institutes and firms subject to market economy regulations.

(2)In 1991, expenditures for pollution abatement by the Dationg Coal Bureau were only 1.14 Yuan/ton ,which is equal to one third of MEC(3.68 Yuan/ton).Inadequate pollution abatement expenditures over the years resulted in constant environmental deterioration. More abatement input is necessary. From 1979 to 1992,the level of coal consumption in China increased 6.8% annually. On the supposition that (1) 1.14Yuan /ton is a pollution abatement charge that the Bureau is willing to pay of the Datong pubic; and (2)the level of consumption increases 1%,then the pollution abatement charge to be paid to the public will increase by 1%,1.1%or 1.2% respectively; then by the years 2006-2009this pollution abatement charge(willingness to pay)will be equal to, or higher than, the MEC. In other words, from 2006-2009 on, with higher willingness to pay (pollution abatement charges),the Datong public and local government will make joint efforts, and together ensure that the pollution abatement expenditures of coal mines at least equals, if not exceeds, the level of MEC. But before this happens, government will have to force coal mines to in vest enough for pollution abatement.

The policy recommendations of coal case study are as follows:

(1)The Central government should establish a special agency to re-price natural resources(including coal resource)and revise the accounting value of such repricing periodically.

(2) The harvesting and utilization costs of natural resources(MEC-marginal external cost)should be compensated. A mineral resource compensation charge(mineral royalty),which is equal to MUC, and an environmental compensation charge, which should be higher than firm's expenditure for pollution abatement, should be levied by state.

(3) Exploration institutes should become profit-oriented firms, and the results of such exploration should be sold on the market at fair market price. It will be necessary to establish an agency to identify and track the results of geological exploration; the agency will also be required to rule on disputes arising from the outcomes of such geological exploration.

c. Case Study: Water Resource Pricing.

The water case study divided water resource problems into two basic categories:

(1) total regional quantity cannot meet demand in long run(in other words, there is a regional water quantity problem);and

(2) the high quality of the regional water supply cannot meet its demand in long run (in other words, there is a regional water quality problem).

We choose Beijing as representative of the first case, and Shanhai as the case study city for the latter.

Economic growth and the raising of living standards result in an increase in demena for water resources. This creates scarcity of the water resource, which in turn causes an increase in MOC(marginal opportunity cost).It seems reasonable to establish the investment and operation

costs of new water-source engineering as the basis of MOC pricing. Usually, there is interval between the construction of new water-source works, and thus the increase in water-supply capacity increases in a step fashion. Therefore, the MOC jumps with the completion of each construction work. However, as far as economic policy is concerned, water prices can only increase gradually. The equation is:

MOCt=MOC1+(MOCT-MOC1)e-q(T-t)

where, in the equation:

MOC is the marginal opportunity cost, or the reasonable price, of water

t is the time period, such that t=1,2,…,T; amongst which

1 is base time period, and

T is the time period in which a new water-source engineering work has been completed.

q is the price adjustment index, such that 0" "

Because the investment for new water-source engineering work is made over a number of years it is necessary to introduce discount rate, 'r', to make current investment its present value. The higher the value of 'r', the larger the value of MOC t.

The Beijing case study made the following assumptions:

(1)in order to eliminate water resource scarcity in Beijing ,it would be necessary to transfer water from Yangtze River:

(2)by the year 2000,the surface water deficiency for industrial and daily life use would be supplied by transferring water from the Yangtze River ,and the water deficiency agricultural use would be supplied by a new water-source engineering work in the Guanting reservoir; and

(3)by the year 2000,water resource prices would be equal to the water resource MOC.

With such suppositions. and with Eastern Line Project of transferring water(transferring water along the Grand Canal)as basis since project data is most complete ,the Beijing case study estimates the reasonable price of surface water for industrial and daily life use as follows(1993 constant price):

Discount Rate: r(%) 5 8 10 12 15

MOC 2000(Yuan/ton) 0.86 1.11 1.32 1.54 1.93

The reasonable price of water for agricultural use was set at 0.50 Yuan/ton (1993 constant price).

With reasonable price as the objective, the water case study suggests examination of water prices with different use scenarios, under different price adjustment index, q.

Considering three new water-source engineering works, which have been or will be constructed, as basis, and assuming both the discount rate, r, and the price adjustment index, q, as 10%,the prices of water source and running water are as follows(1994 constant price):

Price(Yuan/ton) 1994 1995 1996 1997 1998 1999 2000

MOCt of water source 0.24 0.25 0.27 0.42 0.43 0.44 0.45

Price of running water 0.68 0.69 0.71 0.86 0.87 0.88 0.90

The water case study calculates the elasticity of demand for water in daily use. With the price of running water and per capita income (both in 1978 constant pr ice)as independent variables ,and the daily use water consumption rate per capita as a dependent variable, the conclusion of the regression analysis is: both independent variables have marked dependence with dependent variable, but, under cur rent conditions in China (especially with the distinct improvement in housing conditions), the price elasticity of demand is lower than the income elasticity of demand. That is to say, if the price of running water increases 1%, the daily use water consumption rate per capita only decreases by 0.1682%;

if per capita income increase 1%, the daily use water consumption rate per capita increase by 0.5595%, These two elasticities means that, even if price of running water in Shanghai increases according to figures in above table, the daily use water consumption rate per capita will, on average, increase 1% annually from 1994 to 2000,Therefore, in order to keep the daily use water consumption rate per capita(or even the entire daily use water consumption)of Shanghai unchanged, the increase in the price of running water should be higher than the increase in per capita income .

The policy recommendations of water case study are as follows:

(1)It is necessary to establish the reasonable types of financial costs in current water source firms, including costs on engineering for environmental protection and pollution abatement, All financial costs should be adequately compensated.

(2)It is also necessary to establish MOC pricing evaluation rules for engineering works for the supply of surface water,

(3)It is also necessary to levy a water scarcity fee according to extent of water resource scarcity.

d. Case Study: Forest Resource Pricing.

With Baishan City of Jilin Province as the example, the forest case study estimates reasonable price of logs according to its MOC

Because the production cost of logs depends to a great extent on production conditions at the production site, we can substitute average production costs at the site for MPC(marginal production cost). In 1993, log MPC in Baishan City was 383.4 Yuan/m3,

Generally speaking, when estimating MUC, the higher the discount rate, r, the lower the discounted present value; this might encourage the current generation to pay less attention to the benefit of future generations for resource utilization This is harmful for sustainable development. In order to consider the benefits of both current and future generations, it is suitable to set discount rate, r, as 5%.

In 1993,it is estimated that the MUC of standing forest stock in Baishan City w as 171.22 Yuan/m3, With a 'commercially suitable' volume ratio of 62%, the MUC of logs is 276.16 Yuan/m3.

The MEC of logs is evaluated step by step as follows:

(1) First, to estimate the total value of a certain ecological function in local standing forest stock per m3. The ecological functions of local standing forest stock include: water-source conservation; soil conservation; CO2 sequestration and storage; recreation and tourist services; biological diversity protection; and other.

(2)Second, to estimate the loss in value of a certain ecological function when harvesting logs per m3.

(3)Finally, since the ecological value varies depending on people's understanding level and degree of demand for environmental services, which in turn depends on the level in progress of society (which can be represented by Engel's coefficient), the calculated result is adjusted with the development stage coefficient inferred from Engel's coefficient.

According to such an evaluation process, in 1993 the log MEC in Baishan City was 217 Yuan/m3.

On the basis of Baishan City case, we calculated optimal log output, optimal royalty charges and optimal environmental charges of forest resource in China. The results are as follows:

(1)In 1995,the optimal royalty charge for the forest resource, which is equal to MUC 1995 of the resource in China, is 307 Yuan/m3; the optimal environmental charge, which is equal to MEC1995 of the resource in China, is 230 Yuan/m3; optimal log output in China is 103 million m3. The log quantity demanded in the year is 140 million m3.therefore,it is a log shortage of 37m3. On the supposition that 40% of the shortage is made up by substitutes of timber, it is necessary to import 22 million m3 of logs, which is about 6times of current import quantity.

(2)By the rear 2010,the optimal royalty charge for forest resource will be 685 Yuan/m3; the optimal environmental charge will be 358 Yuan/m3; optimal log output in China will be 85 million m3. The log quantity demanded in the year 2010 will be 230 million m3, which means a log shortage of 145 m3.Similarly,suppose 40%of the shortage is made up by substitutes of timber, it will be necessary to import 87 million m3 of logs.

These results show that optimized utilization of Chinese forest resources will bring about a great effect in the international trade of China. The Chinese government should consider relevant countermeasures.

The policy recommendations of forest case study are as follows:

(1)Government should phase out of logging subsidies.

(2)Government should levy on log producers both a royalty charge and an environment charge.

(3)On the basis of measures mentioned above, the government should remove control on timber price in domestic market, at the same time, remove import tariffs and quotas on timber and relevant products. Domestic log output and timber quantity imported should be determined by market.

e. Case Study: Urban Transportation Pricing.

Using Shenzhen as the example, the urban transportation case study estimates the MOC of Various urban transportation means aimed at transporting passengers, and, going further, discusses the strategy for structural optimization of urban transportation means.

In the MOC estimation of various urban transportation means, factors considered are as follows:

(1)self cost of the transportation means, including costs of its purchase, operation and maintenance;

(2)cost of roads occupied by the transportation means, including costs of its construction ,management and maintenance;

(3)cost of parking lot occupied by the transportation means, including costs of its construction, management and maintenance;

(4)cost of traffic accidents, and economic losses due to traffic noise, air pollution damage, and congestion losses.

In Shenzhen, the MOC and its composition of various urban transportation means are as shown in the following table(Yuan/person-km):

Note: In the MOC of various transportation means, self cost includes the costs of purchasing, operation and maintenance, which are paid by the owner of the transportation means; social cost includes all other cost.

* Subway and Light Way are means proposed for development in Shenzhen. With special-purpose lanes and without serious environmental pollution, all costs are shown as self costs.

* * Yuan/ton-km.'Freight car' represents all transportation means for urban freight transport.'Freight car' also occupies both road and parking space, and results in environmental pollution. Therefore, it should share social cost.

In order to compare advantages and disadvantages of various transportation means, in addition to the MOC, losses in both time and comfort should be calculated. The se losses depend on type of transportation used, the distance traveled, the time required for waiting and changing transportation means(which does not exist when travel by private transportation is used),and income (different personal income levels mean different unit time values).Assuming that waiting and changing times of various transportation means are set, and using different distances to travel (1.5,4,10 and 15 km, respectively),our case study evaluates all economic costs, including MOC and losses of both time and comfort, for various income groups taking various means of transportation.

The results are:

(1)If the purchaser of the private transportation means pay only self cost, including losses of both time and comfort, monthly income of1, 250 Yuan (1994 constant price) is a noteworthy line of demarcation. Passengers with monthly incomes higher than this level choose motorcycle as a means of transport, while passengers with monthly incomes lower than 1,250 Yuan choose bicycle (perhaps pubic bus when their travel distance is equal to, or longer than, 10 km).

(2)If the purchaser of the private transportation means pays al costs, including similar losses of both time and comfort, their choices are as shown in the following table:

The table shows that, in Shenzhen, if we structure urban transportation according to whole costs of various transportation means, including

MOC and losses of both time and comfort, the bicycle should be adopted for passenger transport in short distance; motorcycle should be adopted in the short and medium distance; and for long distance, at present, it should be by bus (public or private). In the future, long distance transportation in Shenxhen could be by public bus and/or subway. However, because the purchaser of private transportation means pays only the self cost, including losses of both time and comfort, both the bicycle and the motorcycle unquestionably become the primary urban transportation means.

In order to avoid an unreasonable transportation structure in Shenzhen, pricing and levies should be made according to the entire cost of various transportation means. For public facilities which are utilized freely of with much lower price at present, charges for road usage and for congestion adjustment should be collected according to its entire cost .For transportation means which result in various forms of environmental pollution, strict standard for pollutants emission should be worked out and implemented. Levies and charges for improper emission levels should be higher than expenditures for pollution abatement; and these charges should be levied on transportation means which cannot achieve standards for pollutant emissions.

f. Integrated Accounting between Resources & the Economy.

The main contents of our study concern the accounts system, and input-output accounting, as explained below.

(1) Part One: Accounts System

As central accounting approach of SNA, accounts is very important in practice. Both balance table and accounts are adopted in line with China's new SNA of 1992. Here, we shall focus on the study of Integrated Accounting of Resource-Economy by account-accounting-form. The contents include:

a. Resources can be classified into two parts: physical resources and environmental resources. The principles of accounting include indirect accounting, MOC pricing and applicability .On the basis of classifications and principles, the System of the Trinity of Subject (Economy)-Linkage Satellite (Resource) is put forward. By Satellite Account, the Integrated Accounting of Resource-Economy is worked out.

b. Based on MOC theoretical framework, we put forward the linkage accounts with the differentiation of the three components MOC (MPC, MUC and MEC) as its most important characteristic, and, at department level, we make a link between monetary SNA and physical resource accounts.

c. With the coal study and the forest study as examples, we analyze and explain systematically the formation of a system with MPC, MUC and MEC as accounting indices.

(2) Part Two: Input-Output Accounting

Bringing input-output into SNA is an important characteristic of modern national accounting. The introduction of input-output perfects SNA, expands its functions, enriches its content, and links together the various accounts in it. Our study starts from input-output accounting, clarifies the current input-output table, conducts research on Integrated Accounting of Resource-Economy, and makes appropriate analysis.

The main research includes:

(1) Starting from the traditional input-output accounting table, and by expanding its basic concepts such as input and department according to MOC theoretical framework, we put forward an input-output table for resource-economy accounting, build relevant material/value input-output models, and continue with analysis of relevant resource economy policies.

(2) Based on consideration of the relationship between stock and flow, we redesigned the input-output table, and proposed an input-output table for resource-economy accounting which includes both stock and flow. On the basis of this table, we analyzed broad coefficients of total consumption (including the coefficient of total product consumption, the coefficient of total resource utilization, and the coefficients of total pollutants emission) and broad theoretical pricing(including theoretical product price, theoretical resource tax, and theoretical unit charge for pollution abatement),At the same time ,we put forward the respective relevant final decision models.

2. Possible Research Topics for Study in the Next Stage

The organization of The Resource Accounting and Pricing Policy Working Group and its research topics for the next five years (1997-2001)

is based on the following considerations:

a. CCICED is a high-level advisory body. As its subordinate working group, we are mainly engaged in the study of environment-resource-economy policy. The aim of case studies is to further the study of relevant policymaking.

b. In the current phase, we put emphasis on the study of natural resources. In next phase, while continuing to work on the study of resources, we shall devote more attention to the study of environmental problems.

c. In order to analyze the trade-off between economic development and the protection of resources and environment, we shall study how to reflect the quantitative influences of environmental and resources problems on macro-economy structure, the local economy and micro-economy in a timely manner.

d. Currently, much effort is devoted to building a theoretical and methodological framework. As the framework progresses, case study examples will lead to policymaking studies and recommendations.

e. Both the protection of the environment and its natural resources, and environ mental sustainability, are multi-discipline topics. Therefore, we shall strengthen coordination with other working groups. The emphasis of our working group will be put on the economic aspects of the environment as a multi-discipline topic.

According to such considerations, we recommend study topics in next stage as follows:

a. Sustainable utilization of natural resources (such as coastal fishery resources and prairie resources).

b. Economic methods for pollution control.

c. Environmental national accounting and environmental cost accounting of enterprises(Green Accounting).

d. Economic analysis of biological diversity cases (the scope and extent of the topic depends on the requirement to be formulated by the biological diversity working group).

e. Further study on urban transportation (unless CCICED establishes a transportation working group, in which case the topic undoubtedly belongs to them).

Finally, in accordance with the change in study topics, we suggest that our group be renamed 'The Environment and Economy Working Group'.

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