

# Research on the Restructure and Its Practical Proposal of Water (Natural Monopoly) Industry

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**Abstract:** To restructure water industry, a new model is proposed according to its characters, that is, the transportation web systems of water should be constructed and maintained by public finance governmentally and made it public goods. Private enterprises invest to produce the identical water-good and use the web systems to transport it to consumers competitively, which might form a completely competitive market. Under this model, to avoid "the tragedy of commons" and the overuse of water resources, two considerable proposals are suggested analytically. One is the fiscal subsidy plus market pricing, and the other, the cap-and-trade system of water property right.

**Key words:** Cap-and-trade, fiscal subsidy, natural monopoly, restructure, water.

## Traditional Regulating Methods towards Monopolies

Urban water industry is a natural monopoly. For the deadweight loss of monopoly, four policies have been suggested in economics: □ Antitrust laws. The law gives the government various ways to promote competition, such as preventing from merger and splitting up monopoly into several small companies. This policy is mainly used to those monopoly formed through patent protection. □ Regulating, such as price ceiling, the behaviour of the monopolist. This regulation aims at lowering monopoly's profit, raising consumers' surplus and thus lessening deadweight losses. This is usually used to natural monopoly. □ Turning private monopoly into public enterprise. To make sure that public enterprises would have social profit-optimization and not private profit maximization, the monopolistic public enterprise were bound to charge price at marginal cost. That way marginal revenue equals marginal cost so that it would have obtained a social optimization. But the government bureaucrats, whose only resource is the political system, may become a special-interest group and may corrupt,

which also makes social losses. This arrangement only suits for natural monopoly and now it is most likely adopted in China. □ Doing nothing.

Each of the foregoing policies aimed at reducing the problem of monopoly has drawbacks. While monopoly of nature resource would, for its profit-maximization, limit its quantity of output; this is like a tax of resource (the revenue goes to monopolist rather than government) which is used to prevent "the tragedy of commons" from it being over-tapped of public pools such as water resource. From this standpoint, monopoly owns some positive advantages such as prevention from resource devouring which is worse for environmental protection. Furthermore, regulation or public enterprising himself or herself are not flawless, so the argument is proposed.

All the policies proposed above aimed at natural monopoly produce deadweight losses. One of the characteristics of natural monopoly is economy to scale. Its average total cost decreases as total output increases. Mathematically, it can be expressed as

$$d(ATC)/dQ > 0$$

where  $ATC$  is the average total cost, and  $Q$  is output. So the first-order condition of  $ATC$  does not exist.

Because marginal cost curve would cross average total cost curve only at the lowest point of average total cost, and marginal cost is no less than zero, the natural monopoly's average total cost curve will never cross its marginal cost curve if the monopoly enlarge its outputs as economic return to scale. That is a puzzle for regulators to set price for whatever price-ceiling for public-owned enterprise. If price is set equal to marginal cost, the enterprise would suffer loss. Sustainable operation of the business needs governmental subsidies. Thus, the monopoly has no incentives to innovate but subsidize. That would be a greater deadweight loss for the well-being of society. The price is difficult to set at average total cost because it is varying with the output. These kinds of regulatory system always fail due to asymmetric information about production costs, and, in addition, which gives monopolist no incentive to reduce costs. Whenever price is set no less than its average total cost, the monopoly would, on the one hand, increase its output to get superior profit, and on the other hand, complains about the price makes it loss for desired subsidies. Although each of the regulatory policies is not perfect, European countries tend to take the form of public enterprise and China, too, because of its socialist characters.

### Restructuring Proposal for the Urban Water Industry: A New Model

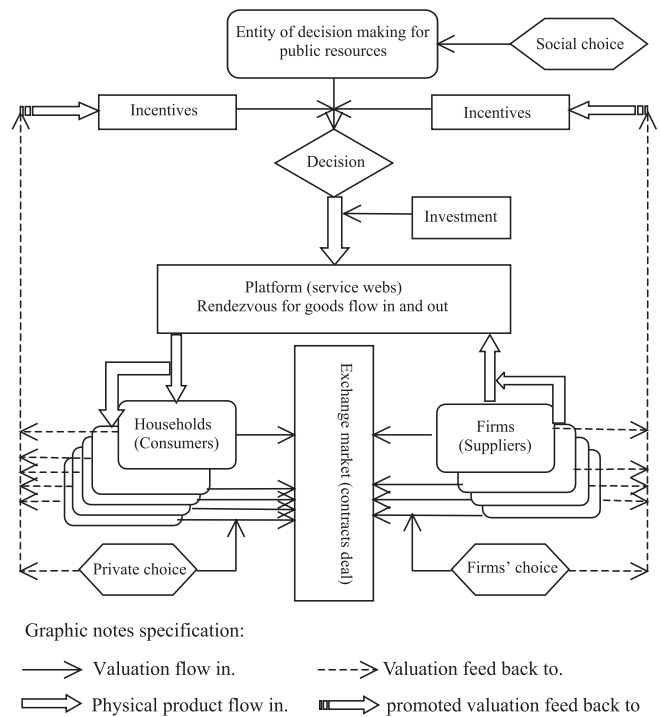
Natural monopoly industry has such characteristics as large amount of fixed cost for infrastructure investment, little amount of variable cost for its operation, and almost the same quality of its products (which is also called identity goods). The large infrastructure investments are mainly used for the web constructions by which all the offered goods or services are transferred and provided to the different consumers. It is this reason which constitutes "barrier to entry".

Consider this kind of barrier to entry and the identity goods. I think we may break up the natural monopoly and reprocess the industry to a more competitive industry by operating the following proposal.

The infrastructure construction of the webs can be invested and maintained by the government, just like roads or bridges which are public goods. The government business should be separated from the production process. Any firm could fairly take advantage of the webs (say, public platforms) to provide the goods or services for her customers if she owns the ability and desire to produce it, charged or discharged to use the web. Because of the attribution of identity goods, the only work for

administrators to do is to record the firms' flowing in quantity of water goods respectively, which can be done now very easily and automatically. Under the driving of profits and due to the breaking up of barrier to entry, private enterprises would like to enter the industry. They would produce and do marketing competitively to use the web platform of transportation. All of these would make the "natural monopoly" more competitive than monopoly. By the way, the infrastructure investments of the web can be raised by public finance, or by other different forms of finance such as BOT.

The running of this re-processing can be modelled graphically as in Figure 1.



**Figure 1: New model of water (natural monopoly) industry.**

### Interpretations of the Restructuring Model

After the re-processing, the markets consist of three types of entities concerning property right. They are: *The government*. Who represents the public and owns the platform of transportation system and who undertakes the macro-administration of the tapping and using of the public resources. *Entities of firms*. Who, using (or consuming) the platform of transportation system, produce the product (i.e. water) and sell it to the households (or consumers). *Households*. Who buys and receives the product from the transportation web. These

three types of entities have their own choices or targets respectively, and interactively, playing the game to win maximally in the market.

There are two kinds of platform. One is the platform of the web used to transportation, the other one is the platform of exchange marketplace used to deal contracts.

The targets of government would be optimizing social well-beings. Households and firms, through supervision system and voting process, give incentives to the government to construct and maintain the web platforms.

The choices of firms are profit-maximization or firms' value-maximization. They, on the one hand, would negotiate with government about the capability and arrangement (or distribution) of the web platform for the purpose of decreasing outside costs such as fees, resource tax, dealing contract cost, etc.; on the other hand, bid for households competitively by promises about their services. Because physical goods have identity, complete competition or oligopoly (such as, Bertrand Model) would price indifferently. Households choose supplier only according to firms' qualities of services such as balance advantageousness, the amount of overdrawn, and exception handles. These would encourage firms to increase production efficiency and service qualities.

The choices of households are utility-maximization. They can select freely among firms to deal contract for the products. If the price is too high, they would complain to the government, compel the government to increase investment of the web so as to adjust the capacity of the transportation system. The households and the firms may go together to influence the government of the web's using fees. If the public resources are over-tapped that make it an environmental problem, the government may also get a great pressure.

So, the governments will have to balance the benefits of all the entities. The allocation of the public natural resources will be undertaken broadly through the web platform distribution by governments. Thus, the goods will be traded in a completely competitive market, the invisible hands would guide the price to its equilibrium, and all of which would optimize resource allocations spontaneously.

Concerning water industry, both tap water and wasted water, the re-procession may embrace four aspects according to the public webs' usages: tap water for production uses, pure water for households' uses (can be drunk directly), released water from rain, and wasted water from production and daily living. In China, we have already owned pipe webs of tap water and sewage webs of rain. Shanghai is constructing pure tap water

pipe webs. The sewage webs of wasted water are now under planning programme in most of the cities in China because of the requirements of regulated proportional treatment ratio for the purpose of environmental problem. The future construction and restructuring should melt the re-process considerations into their programming projects lest unnecessary losses, I advice.

In present day China, we have already recognized that the wasted water should be treated before being released to rivers and that some planning programmes for waste water treatment, so as the building of sewage webs, are a constructing tendency inevitably. But if the sewage webs are built blindly, i.e. without well-defined property right, it might lead to inefficiency, new monopoly, and new subsidy. So it is an important consideration of the restructuring for the web-building programmes and their distribution and it is deliberately for the operational basis of the recent appearance of water groups' financing and investing in waste water treatment. Pure drinking water and other tap water separating is another developing tendency. The demand of bottled pure-water is increasing quickly. The pipe webs for the pure water can lower the transporting cost and can get it done once and for ever. Shanghai is now constructing pure water pipe webs and we should make it systematically into the new model of restructure process.

For the restructure being implemented successfully, apart from the construction of the public web platform, the following considerations have to be satisfied:

- We must supervise the quality of flow-in products effectively. A system of quality assurance is necessary too. The supervision after restructure, now, will be done from the solely monopoly to lots of firms, which will increase the cost of the work. The firms provide identical water goods. It is unnecessary and unable to distinguish it from the products flown into the webs. This wants the quality of flow-in products to be fully assured; otherwise, the inferior and/or fraud products would produce an externality. Further more, this, when serious, might paralyze all the supply chains and threat the whole society. Thus, this must be seriously considered, and so does the quality degree of treated waste water releasing either from professional water treatment firms or from other water treatment channels.
- The construction of the platform for exchange account system. (This platform will not cost largely.) The contracts are dealt in marketplace, but the delivering flown into consumers' home through web should be

in phase according to households' uses. There are time-differences and spatial-differences in the deals. The flow-in measurement can be recorded by the method of being broadly used pre-pay system of IC card. The initial delivery (supplier to web platform) measurement can be recorded by flowmeter. And a production quantity assurance system must be established so that households could consume the products just in time sufficiently. (This can be analogized to with bank system. The web is like central bank, suppliers like commercial bank that has to afford bail to central bank.)

- Establishing relevant exchanging market for property right so as to keep the power of control over resource allocation. (This part of re-procession would not be counted as the cost of it, because even without the process, the clearly property right and the power of control over the tap of natural resources are the future direction of reform in China. So the opportunity cost is little.)

To provide a sustainable quantity of public natural resources, we may take advantage of different price systems in production marketplace, and mix it with a marketplace for property right. For example, the total quantity of would-be tapped water resource in each year should be capped and any firms and/or households are rationed a certain amount of quantity (water permission). They can go to the property marketplace to trade the permission. The wasted water from production may also do like this. (It is called the cap-and-trade in the U.S.)

- Market economy, unlike central planned economy, is a lawful economy. Its rules have to be openness, transparency, and enforceability. Re-processing the natural monopoly in China should be accommodated with suited and enforced legislation environment. Without this, all the re-procession should not be implemented ultimately. (Legislating has its cost, but the cost or cost added will not be large.) The total marginal cost of the restructure will not be high. The current web platforms are state-owned in China. They can be separated from the water enterprises, about which the only assets are of production processes. The market opens to any corporations to compete with each other for profits. The benefits of breaking up the monopoly would be good in the long run, theoretically.

In short, the characteristics of natural monopoly are that the investment of infrastructure is very large and the proportional ratio of investment used to the transportation web is large too; and that the product is identity good.

According to these, we can re-process the industry as such that separating the web assets from enterprise and making it public resources, such that breaking up the original monopoly industry and opening it to any corporation to compete for profits and making it a competitive market. The re-procession's main clue is that the governments, who represent the benefits of society, may control over the natural resources, finance and invest the web platform to lower or break up the barrier to entry, so that a competitive market would be formed. This re-procession model can be used not only to water industry such as pure drinking and treatment of wasted water industry, but other natural monopoly such as natural gas, electricity, and communication as well.

## Two Proposals for Urban Water Industry's Restructure

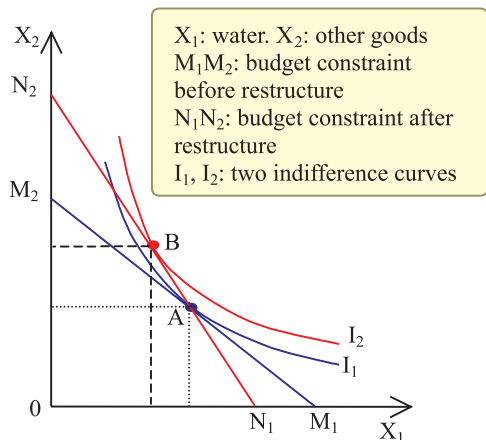
The purpose of restructure is to introduce the price signal, i.e. invisible hands, into the market for its full working to allocate resources efficiently. To do this, here are two referable proposals suggested: the fiscal subsidy plus market pricing, and the cap-and-trade system of water property right, in both of which the price is freely fixed, according to demand and supply.

### I. The Fiscal Subsidy plus Market Pricing

According to the restructure model, when the webs are built as welfare, the governments should make a proper high price (denoted as  $P_0$ ) for getting crude water and for using the webs. Supplying firms use the webs competitively (who sells, who uses). The price ( $P_e$ ) of water is auctioned in the water exchange market. The supply curve is the sum of the marginal cost of production (MC) and  $P_0$ . Water good is necessity and its demand is inelastic which can make sure that the market price ( $P_e$ ) is no less than its total marginal cost ( $P_0 + MC$ ). The governments earn  $P_0$  and can subsidize it back to citizens on schedule. When supply exceeds demand, the price decreases, and when demand exceeds supply, it increases. So the firms invest responding to the profits. Because of no entry barriers, it would constitute a complete competition situation.

The increasing of water price will decrease its consumption and may increase other goods' consumption for substitution. This effect will increase living standard (see Figure 2).

The horizontal axis is quantity of water good, the vertical the all other goods sets. A citizen chooses consumption bundles between the two goods. Utility



**Figure 2: Consumer choice of fiscal subsidy plus market pricing**

indifference curve means the same satisfactions of the bundles. Before the restructure, the real income budget constraint is line  $M_1M_2$ . That is, point  $M_1$  is the quantity of water the citizen can consume using all his income, and point  $M_2$  is the quantity of other good sets with all his income. If consumers are rational and utility maximization, the optimal choices would be point A. After the restructure, water price increases, to make sure the living standard do not decrease, the governments subsidize the citizens to let the new budget constraint line cross the point A. The line  $N_1N_2$  is the budget constraint after restructure.  $N_2 > M_2$  represents getting subsidy. The new equilibrium bundle is point B. One can know from the figure that water consumption decreases but the living standard increases after the procession, which means that the deficiency of water resources is mitigated, and at the same time people reach to higher living standard.

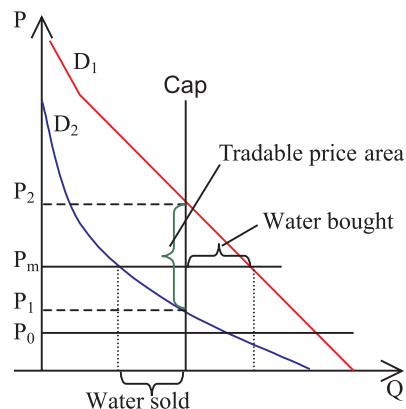
To make sure that citizens' living qualities are not lowered with the upgraded water price, we should pre-determine an expected water price and subsidies according to average economic consumed level. If water over-consumption were impeded spontaneously and thus less wasted water released through the procession, then the expenditure of environmental consideration would be alleviated, and environment would be improved.

## II. The Cap-and-Trade System of Water Property Right

The governments determine a ceiling quantity of water resources according to its sustainable uses (Cap). The price of taking natural water, with necessary permission, are made low or free, as well as using transportation webs. The permissions are fairly rationed to citizens according

to the Cap, which maps public resources. The citizens choose supplier freely, with self-interest, exchange the permission to supplier to buy water to consume at lower price ( $P_0$ ), or "trade" the permission to earn (a higher market price,  $P_m - P_0$ ). One can also buy water at price  $P_m$  without permission. Any firm(s) can buy the permissions to produce water and sell it for profits. They can enter the market with no barriers to serve the citizens competitively.

The proposal (called Cap-and-Trade System) can not be implemented without the support of intellectual prepaid IC card flow-meter measurement. When family water account is made, his permission (property right) will be delivered to the account on schedule according to the size of the family. The permission then can be used either to buy water or to be sold to get earns. The exchanging process of this proposal is shown in Figure 3.  $D_1$  and  $D_2$  are two different family's demand curves. With the permission, they can buy water at price  $P_0$ . When the price is higher than  $P_1$  but less than  $P_2$ , family 2 would sell some of his permission at price  $(P_1 - P_0)$  and family 1 would buy it at price  $(P_2 - P_0)$ . In equilibrium, the price would be  $(P_m - P_0)$ . Or family 1 can buy water from supplier directly at price  $P_m$ . Because of the Cap and the permission being delivered on schedule, the total water resources would not exceed the expected controlling quantity; the permission would not be monopolized either. The permission, on the one hand, is freely delivered to families, which embodies the character of public resources; on the other hand, it has to be with the price  $P_0$  to consume water, which means a resource consumption tax. All of these are in accordance with the character of social welfare: Who uses water economically, who gets benefit. That is a full incentive to water consumption.



**Figure 3: Cap-and-trade system.**

## The Comparisons of the Two Proposals

### The Same

Because of the separation of the transporting webs from water supplying industry, the fixed cost of firms is lowered considerably, which would induce firms to enter this industry, forming a completely competitive market, just like the current bottled water industry. The procession would decrease deadweight losses, increase the efficiency of allocating water resources, and so does the total social welfare.

The market price, as a signal, will affect water uses. High price would decrease water consumption. Because people will earn from saving water, they might rationally use the thrift equipment. By the institutional innovation—with the stimulation by market but government, the consuming structure, as well as industrial structure, would be improved, and so would be the circumstances of environmental protection industry.

Water is replenishable but depletable common resource. Common resources belong to public. The proposals emphasize that the benefits from saving water belongs to the saver, which would turn away the “tragedy of the commons”. In addition, the proposals embody the property of replenishment—either the fiscal subsidies or the permissions are delivered on schedule, e.g. monthly. Thus, the restructure proposals are in accordance with the attributes of water resources.

### The Differences

**Price:** Proposal I likes a regulated price floor ( $P_0$ ). High or low of the  $P_0$  affects water consumption. The market price ( $P_m$ ) of Proposal II is determined by two variables—the demand structure and the Cap. The Cap and the total demand affect market price. Because of the same original permission, the more is the demand structure differences, the more the exchanging quantities of water, and so does the price fluctuate.

**Trade Contents:** In Proposal I, water is traded directly in the only market. The quantity is input in IC card which can be used as swift-on to consume water. In Proposal II, there are two kinds of market. One is for water; the other is for the permission. In the water market, there are two sets of price: one is low price with permission, the other the high price without permission. In the permission market, only permissions are traded. Though the two markets may be in one marketplace, it is more complex than Proposal I.

**Practicability:** Proposal I is relevantly easy to prepare and operate because the changing is less. We have had such pre-experiences that foodstuff and meat prices were

adjusted high designedly with subsidies to citizens. The practice of Proposal II needs more preparations, such as determining the Cap, how to deliver it, the establishments of water property right accounts and its exchanging market, etc.

**Saving Effective:** Proposal I has less saving effective. Increased price might not decrease water consumption largely because of the subsidy. So its incentive to saving is less unless the price is designed very high. Proposal II limits total quantities of water uses. Thus, its saving effective can be controlled thoroughly by governments so as to easily reach to the targets of sustainable development and environmental protection.

**Fairness:** Citizens can get from Proposal I the subsidy, whereas Proposal II the permission. Citizens consume water at the same high price in Subsidy which makes poorer, psychologically, unacceptable. And further, when inflation occurs, the poorer would be affected more. With the permission in Proposal II, poorer can consume water at low prices and only richer may use high price water which makes poorer, psychologically, consider fairness. When inflation occurs, the price of permission would increase which makes poorer get more complement by selling permissions. So Proposal I is much disadvantageous and uncertain (so does the risky) for poorer than Proposal II is.

**Benefit and Cost:** Although they can both increase the efficiency of water uses, the costs and effectiveness differ largely with time horizon. Proposal I works better in short run but cannot overcome the overuse and over-release problems for the long run. Proposal II, though costs and uneasy to practice in short run, would work better for the long run because of its saving effectiveness. The situation of changing water use is strategic, and the social benefits from Proposal II would increase obviously with the time.

## Some Possible Would-be Problems and Their Countermeasure

The proposals may produce some new problems and we must take care. One is about the delivering objectives. The subsidy or permission can only be operationally delivered to local citizens, when different regions make the restructure differently in step. This will make flow-in people worse off and flow-out people better off and lower the allocating efficiency for human capital resources.

The second is the relation of water for living uses and for production uses. Living use water can be delivered according to ID card management. But how is the

production use water subsidized or delivered with permission? Without subsidy or permission of production use water, it would increase production costs and make local economy decline in time. Thus, subsidy or permission is necessary. How to do this we can refer to, such as, employment, character of industry, production value or taxation. Referring to employment is like that employee contributes their water to firms, which is positive to employment. Referring to industry, because different kinds of industry exhaust water differently, it is not good for industrial adjustment if industry water use gets more subsidy, but good for production stability. Referring to production value or taxation is like a tax rebate.

The third is how to practice public businesses such as hospitals, schools, fire extinguishing, city cleaning, city greening, government offices, etc.? If renewed water can be used to the business, then we need not subsidize it. This can make the public business become the main user of renewed water.

The fourth is the special industry whose production quality is much related to pure water such as food manufacturers and restaurants. High price water may lead them to use much less water for cleaning process. So it needs more supervision of the regulators to work.

Besides, to avoid selling permissions or making subsidy badly used, that makes the necessary uses of water for people's livings and lives impossible, we should deliver some of the subsidy or permission with physical water good and make sure that people can only trade the permissions of past saving. Such strategies can prevent

“problem family” from their socially negative effects of the restructure.

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