Analysing the Diversity of Water Pricing Structures: The Case of France

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ANALYSING THE DIVERSITY OF WATER PRICING STRUCTURES: THE CASE OF FRANCE

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Paper published in : Water Resour Manage (2007) 21:861–871
Author-produced version of the final draft post-refeering
The original publication is available at :
http://www.springerlink.com/content/c54255108u4n5797/

Abstract:

This paper presents the results of a 2003 national survey of urban water pricing structure implemented by 429 district level water utilities. After providing some background elements on the diversity of existing water pricing structures, the paper shows how each structure can be used to achieve different management objectives (water allocation efficiency, costs recovery, and equity). It then describes the structures adopted by French water utilities, showing that flat rate are rarely adopted; declining blocks frequently used; and increasing blocks pricing which should be used to promote water use efficiency remain extremely rare. A statistical clustering is then conducted and a typology of situations elaborated. The paper concludes with highlighting that current pricing structures are influenced by past practices and that the dominant objective of water utilities is to cover costs.

Keywords: France; survey; water pricing; tariff; urban

1. INTRODUCTION

In many regions of Europe, water is increasingly scarce, as water demand goes up and pollution reduces available resources. Simultaneously, the cost of producing drinking water rises, as water has to be transported over longer distances and/or to be treated at a cost which has been continuously rising over the last two decades – in particular due to the cost of removal of nitrates and pesticides and the strengthening of quality standards. In response to these changes, water is now clearly perceived as *an economic good* which should be charged to users in order to provide economic incentives to save it (efficiency objective), to recover direct and indirect costs related to its production (cost recovery objective), taking into account equity considerations and constraints of administrative and political feasibility (for an illustration of the political dimension see (Dinar, 2000)). This principle has now been incorporated in European legislation with the promulgation of the European Water Framework Directive (WFD) of October 23rd 2000 which aims at restoring good ecological status for all European waters. Concerning water pricing, the WFD promotes (without imposing) the principle of full cost recovery, requiring that the beneficiaries of water services should provide an "adequate contribution" to the recovery of the direct costs as well as for environmental and resource costs they generate (Brouwer and Strosser, 2004). The WFD also requires that pricing policies be used to provide adequate incentives for consumers to use water resources efficiently, clearly calling for a change of practice in terms of water price level and water pricing structures (European Commission, 2000).

An abundant literature focuses on the analysis of the impact of water price level on water use decisions, mainly through econometric techniques which aim at assessing the price elasticity of urban water demand (for a review see Arbués *et al*., 2003). Most of these studies generally assume a simple two-part pricing structure (fixed part plus volumetric price) neglecting that water utilities charge users with very different and sometimes sophisticated approaches. Significant research has also been carried out to analyse the impact of water pricing structure on water use efficiency, cost recovery and equity, relying on both theoretical and on case studies (Howe and Linaweaver, 1967, Dinar, 2000). However, relatively little attention has been paid to the factors which determine *in practice* the choice of a pricing structure by local water utilities. This issue is of particular importance in countries like France, where drinking water networks are owned by several thousands (usually public) water utilities, each one defining its own pricing policy, taking into account various local constraints. Better understanding this diversity of practice is considered as a prerequisite to any policy recommendation or action at the national in that domain.

This paper presents an attempt to fill this gap through a description of

the diversity of existing water pricing structure in the drinking water sector in France, using primary data collected in 2003. The first section of the paper provides some theoretical background elements, highlighting that the choice of water pricing structures is often guided by considerations of equity, cost recovery and resource use efficiency – three management objectives which can be contradictory. The second section then describes existing pricing structures in France, based on a national survey done in 2003. This data set is then analysed to highlight the factors which explain the choice of water pricing structures.

2. THEORETICAL FRAMEWORK

When setting water prices, water utilities are following multiple and sometimes contradictory management objectives (OECD, 1987, Dalhuisen and Nijkamp, 2002, Arbués, *et al.*, 2003): *efficiency*, which consists in allocating water to users to maximise social welfare; *equity*, which in this paper has the same meaning as fairness or poverty alleviation, and consists in guaranteeing a minimum access to all (Dinar, *et al.*, 1997, Lant, 2004); and *costs recovery* which consists in balancing revenues from users with direct (and sometimes indirect) costs induced by water extraction, purification and distribution: in other words, the full cost to recover comprises the full supply cost (operation and maintenance cost and capital charges) plus the opportunity cost and economic and environmental externalities (Rogers, *et al.*, 2002, Lant, 2004). Other secondary objectives, which can be more interpreted as constraints, are also present: a pricing structure which must be simple to be understandable, be acceptable to be applied, guarantee public wealth, etc. (OECD, 1987).

Most water utility managers actually try to achieve three main objectives simultaneously, although the relative weight of given to each one may vary depending on the social, economic and environmental context. This section shows how different pricing structures can be used to achieve these three main objectives.

2.1. Description of water pricing structures

Water is priced according to a generic function: $B = aX + b$, with B, the total bill, X the water consumption level (in m^3), a the price per unit of water used; b the fixed part.

The proportional part (*a*) can be either *constant* whatever the level of water consumption or priced “per block”. The block pricing can then increase with the consumption level (*increasing block* rate) or decrease (*declining block* rate). Complex pricing structures combining increasing and declining steps can also be met.

The fixed part (b) can be charged in very different ways: it can consist in a flat rate charged uniformly to all customer, independently from their characteristics (the same amount is charged to a single household living

in a detached house and to the owner of a 10 apartments building owner); the amount of the fixed part can also be indexed on the number of flats connected to the same meter, the number of inhabitants, the size of the apartment, the duration of the stay, the number of taps, etc. In some cases, the fixed charge is made partly proportional to the volume of water used (4 € for each block of 20 m^3 consumed for instance).

Three main types of water pricing can be then found. If a = 0, the water bill does not change with water consumption level: it is a flat rate structure; if b = 0, the water bill is strictly proportional to water consumption: it is a volumetric rate structure; if “a” and “b” are strictly positive, it is a two-part rate structure.

2.2. Households sensitivity to water pricing structure

The link between water pricing structures and the level of achievement of some objectives depends in particular on the type of price toward which households are sensitive. For some authors (Gottlieb, 1963, Young, 1973, Foster and Beattie, 1979, Shin, 1985), consumers react to the average price because information is costly (Shin, 1985): they are supposed to be uninformed on the water pricing structure, to not know when they change of block, etc. For others (Howe and Linaweaver, 1967, Nieswiadomy and Molina, 1991, Lyman, 1992, Nieswiadomy, 1992), consumers react to the marginal price.

But some studies revealed more complicated behaviours: a research conducted in Denton (Texas) between 1976 and 1985 on 101 households (Nieswiadomy and Molina, 1991, Nieswiadomy, 1992, Taylor, *et al.*, 2004) showed that behaviours are different if block rates are increasing or declining. Water consumers seem to be sensitive to marginal price when block rates increase, and to average price when they decrease. A median option was initiated by Nordin (Nordin, 1976) for two-part tariffs: he assumes that consumers react at both marginal and average prices.

In the rest of the paper, it is assumed that households are sensitive to marginal water price – an assumption allowing us to link water pricing structures to the three main objectives previously cited.

2.3. Which pricing structure for which management objectives?

Because water pricing structures are complex, it is impossible to have a strict relation between one structure and one objective. But we can point out several trends taking into account the two dimensions of water pricing structures (Figure 1).

When the dominant objective is efficiency, the water supply manager will generally charge water with a volumetric rate structure or with a two-part rate structure where the fixed part represents a small percentage of the average water consumption (120 m^3 per household per year in

France). It can also use increasing block rate to reflect the increasing marginal production cost and to stimulate efficiency gains; if a_1 and a_2 are two block prices, the higher is the ratio $[(a_2-a_1)/a_1]$, the more efficient is the pricing policy - if we assume that water users are sensitive to water price, espacially if the price increase is high (Pouquet and Ragot, 1997).

Block pricing can also be chosen for equity reasons, the first block corresponding to basic needs being free of charge or charged at a very low price for social reasons. However block pricing may also have adverse effects, in particular if there are shared connections and then no metered private water connection (Whittington, 1992). Moreover, it is sometimes difficult to dimension the first block at the right size, because the social water need depends on the household size (Boland and Whittington, 2000).

When cost recovery is the main objective, the fixed part will represent a significant share of the average bill (a*120+b) to secure revenues; the manager can also use declining block pricing to maximise its water sales by inciting users to consume water. This type of structure is however not equitable, small consumers pay a much higher average price than large consumers – unless a special tariff is designed for specific segments of the society.

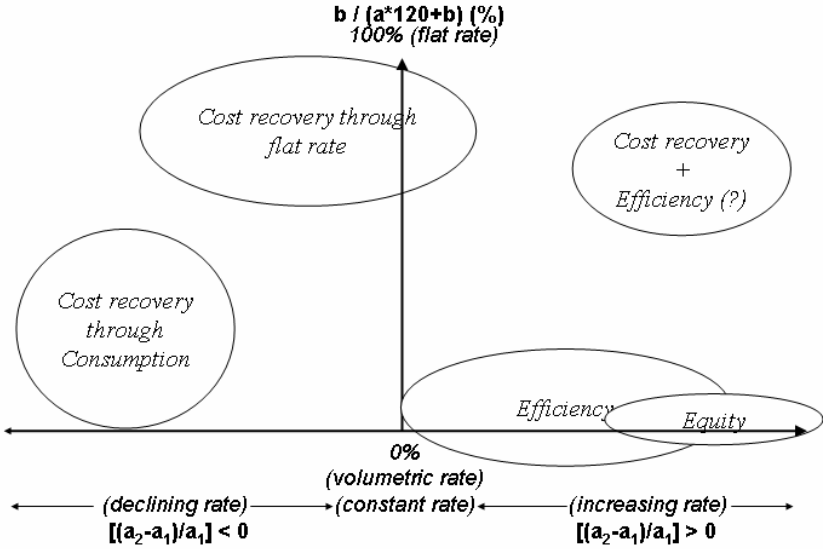

Figure 1. Water pricing structures and management objectives

In practice, the widely used two part rate structure is an intermediate way to reach partly the three objectives according to the weight of each part (Feldstein, 1972). For example, the cost recovery and the efficiency objectives could be attained with a specific structure as: a heavy flat part combined with an increasing proportional part with a free first part or very low (fixed to cover essential needs or “normal” needs) and a second part really high in order to dissuade households to consume more.

3. URBAN WATER PRICING STRUCTURE IN FRANCE: RESULTS OF A 2003 SURVEY

Let's now look at the French water pricing structure situation, analysed through a survey conducted in 2003 at the national level. A questionnaire (four pages) was mailed to 1630 French districts selected following a stratified sampling procedure (taking into account three types of factors: geographic, population size, level of seasonal population). It was structured to collect information on the characteristics of water and wastewater management utility, the detailed water bill, and the eventual existence of pricing specificities. The response rate was 29%, with 429 responses totally exploitable. The results were adjusted to be fully representative of the French situation.

3.1. Water pricing levels

The average price in France in 2003 is 2.64 €/m^3 (Table 1). However, there is high different level of prices, in particular because 39% of French districts have no collective sewerage and do not price it.

In this average price, VAT and Water Agencies taxes are included. The "polluter pays" and "user pays" principles are indeed two key principles underlying the French Water law of 1992 (amended in 2005 to comply with the WFD): taxes are is systematically charged to users and polluters, and their level are proportional to the volumes of water abstracted and consumed or pollution loads discharged in rivers. The financial revenues of these taxes are then used to finance actions and projects aiming at improving the status of water resources. It is however not clear if these taxes are proportional to environmental and resource costs generated by those who pay them. Only one study has actually addressed this issue (Fredefon and Laurans, 2004), suggested that cost recovery level is significantly lower than estimated above if environmental and resource costs are taken into account.

French Water Agencies try to apply the Polluter Payer Principle and the User Payer Principle: they tax users for their water extraction, their water consumption and their water pollution at a level depending on water scarcity and on the generated pollution. However, these taxes do not cover, nowadays, all economic and environmental costs (Fredefon and Laurans, 2004).

On average, the fixed part is 31 euros for the water part (equivalent to a consumption of 29 cubic meters) and 11 euros for the sewerage part (14 cubic meters consumed). This law level is mainly explained by the fact that sewerage is principally priced with a volumetric rate.

	Districts with sewerage	Districts without sewerage	All French Districts
Water			
• Proportional part	1.36 €/m^3	1 €/m^3	1.35 €/m^3
• Fixed part	31 €/m^3	41 €/m^3	31 €/m^3
• Fixed part in equivalent water consumed	29 m^3	46 m^3	29 m^3
• Average price (for 120 m^3)	1.63 €/m^3	1.36 €/m^3	1.62 €/m^3
Sewerage			
• Proportional part	0.94 €/m^3		0.94 €/m^3
• Fixed part	11 €/m^3		11 €/m^3
• Fixed part in equivalent water consumed	14 m^3		14 m^3
• Average price (for 120 m^3)	1.03 €/m^3		1.03 €/m^3
Total			
• Proportional part	2.36 €/m^3	1 €/m^3	2.28 €/m^3
• Fixed part	43 €/m^3	41 €/m^3	43 €/m^3
• Fixed part in equivalent water consumed	23 m^3	46 m^3	23 m^3
• Average price (for 120 m^3)	2.66 €/m^3	1.36 €/m^3	2.64 €/m^3

Table 1. Average French water price in 2003

3.2. Overview of existing pricing structures

In the large majority of cases (for 94% of French districts corresponding to 93% of French population), water is charged with a two-part structure. The volumetric rate is only found in 3% of French districts (representing 6% of the population). The flat rate structure remains anecdotal, concerning only 3% of French districts (rural), which hardly represents a few per mile of the population.

The fixed part corresponds, on average, of the price of 23 cubic meters (b/a = 23). This average ratio is higher (b/a = 46) in districts without collective sewerage (and also smaller).

	% of districts	% of population
Simple	57%	71%
Declining	36%	20%
Complex	3%	4%
Increasing	1%	5%
Flat rate	3%	-

Table 2. Distribution of the types of the volumetric part (for water and sewerage services)

Proportional water part (always including, except for districts with no water meters, the different Water Agencies taxes) charged to users is constant in 57% of the districts, corresponding to more than 70% of the

population (Table 2). Surprisingly 36% of the districts use declining block tariff structure and only 1% (5% of the population) an increasing block structure. Declining block rate is especially found in small districts where it is probably implemented to maximise sales and to secure cost recovery. An additional 3% of French districts have a price structure more complex, combining increasing and declining block rates.

We have described above the total bill (corresponding to both drinking water and sewerage services). This bill is strongly influenced by the "drinking water" part (Table 3). The sewerage part, for the 61% of districts which have a collective sewerage, is priced in a different way. This difference is particularly high in terms of population: when it exists, sewerage is priced with a volumetric rate for 68% of French inhabitants.

		% of districts	% of population
Drinking water	Volumetric rate	4%	6%
	Two-part rate	93%	93%
	Flat rate	3%	-
Sewerage	Volumetric rate	22%	63%
	Two-part rate	34%	27%
	Flat rate	6%	2%
	No collective sewerage	39%	8%

Table 3. Distribution of rate structure for drinking water and sewerage separately

Moreover, the constant rate structure dominates for sewerage part (83% of districts, 91% of inhabitants) and a block rate structure is an exception (7% of districts and inhabitants). But flat rate is a bit more utilised than for "drinking water" part, concerning 9% of French districts (and 2% of population).

A part this structure, some specificities can be highlighted: one third of districts have special pricing structures (mostly declining) for industries; one third of districts proposes a special "green" tariff if households take a specific water meter for outdoor uses (which do not discharge waste water, then sewerage part is not priced); finally, 15% of districts put a sewerage flat rate to households who have their own water (groundwater through tube-wells or rainwater), because they do not consume supplied water but discharge waste water in the sewerage system.

3.3. A typology of French urban water pricing structures

A cluster analysis (using Ward method) was carried out to make a typology of districts homogeneous in terms of pricing structure. A partition of the sample into six groups was to be the most relevant one, pricing structures differing mainly one from another according to district sizes and to the seasonal population level (which conducts to oversize water and wastewater infrastructures) (Table 4).

	T1	T2	T3	T4	T5	T6	Total
Average population (inhabitants)	921	3389	526	5146	21400	209800	14994
% of districts with high seasonal population	14%	43%	37%	9%	11%	0%	28%
% of district with sewerage service	0%	88%	54%	100%	100%	100%	70%
Proportional part							
Simple	73%	45%	52%	61%	82%	83%	58%
Increasing block	0%	7%	2%	12%	5%	13%	5%
Declining block	27%	32%	36%	18%	5%	4%	28%
Complex	0%	14%	2%	9%	8%	0%	5%
Flat rate	0%	1%	9%	0%	0%	0%	4%
Fixed part							
% of districts with fixed part = 0	0%	0%	4%	3%	13%	9%	4%
Fixed part (in euros)	57	103	59	42	33	23	61
(in % of the bill)	27%	31%	33%	13%	10%	7%	26%
(in equivalent of cubic meters consumed)	50	61	63	23	17	11	48
Proportional price							
Average price (euros/cubic meter)	1.8	2.9	1.7	2.7	2.7	2.6	2.2

Table 4. Characteristics and pricing structure for the 6 districts types identified through cluster analysis.

As presented in Table 4, the main objective underlying the choice of a pricing structure is clearly cost recovery for districts of types 1, 2 and 3 which are small (less than 500 inhabitants or medium size districts (500 to 2000) and often facing a high seasonal population rate (respectively 43% and 37% for districts of types 2 and 3). These districts have a relatively high fixed part which represents respectively 27%, 31% and 33% of the average water bill, equivalent to a consumption from 50 to 63 cubic meters (based on the district volumetric price). Most of them have implemented a two part pricing structure, with a frequent use of declining block rates (respectively 27%, 32%, 36% of the districts in each group). Increasing blocks and complex structures are implemented by 21% of districts of group 2, which often have a collective sewerage system and are characterised by a high level of seasonal population.

Pricing policies implemented by districts of types 5 and 6 – which include all the district of population ranging between 10 000 and 100 000 inhabitants (for type 5) and more than 100 000 (type 6) – are generally more simple: in both types, more than 80% use simple two part structure and only 18 and 17% have adopted block pricing. Pure volumetric structure has been adopted by respectively 9 and 13% of the districts. The level of fixed part is also much lower than in the first 3 groups: it corresponds on average to 7 and 10% of the average water bill. This reflects higher level of concern about efficiency of water use than slam districts have.

Type 4, which corresponds to districts with a population between 3000 and 10 000 inhabitants and low seasonal population, is in an intermediate position. Block pricing is implemented by 29% of the districts and the

fixed part represents 13% of the average water bill.

3.4. Discussion

Three main trends can be drawn from the survey.

3.4.1. A current structure influenced by past.

Current pricing structures are highly influenced by past pricing practices, in particular for small districts (500 and 3000 inhabitants) which had to abandon flat rate tariffs after the promulgation of the 1992 French Water Law. A frequent situation concerns districts which were previously charging water with a fixed part (*b*) entailing the right to use a given volume of water (*V*) free of charge and a volumetric part (*a*) for all cubic meter exceeding the initial quota. After the 1992 water law, the quota was suppressed, the fixed part b was reduced to b' and the first block v is now charged at a rate *a'=[(b-b')/V]*.

3.4.2. A structure to recover (supply) costs.

Supply cost recovery is the main objective that determines the choice of urban water pricing structure. As districts look for adjusting their water pricing structure to water and wastewater cost structure (which are mainly fixed), they usually adopt two-part structures. Only large utilities which can make economies of scale choose volumetric structures.

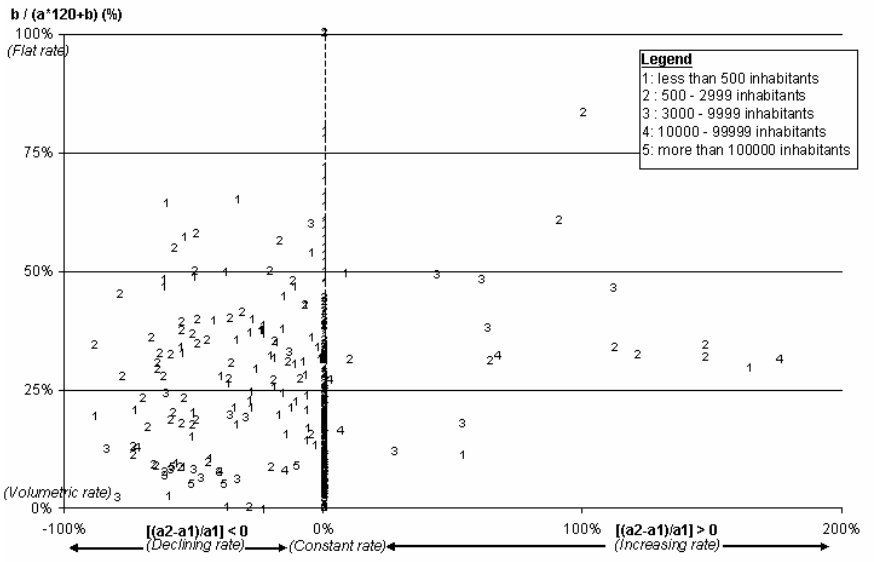

Figure 2. Urban water pricing structures for interviewed districts according to their size

Furthermore the fixed part is higher in small districts (*Figure 2*) and/or with a high seasonal population. And as the average price (calculated for 120 cubic meter water consumption) is the same in districts with or without seasonal population, it shows that districts tend to adopt the urban

water pricing structure, which allows them to share costs in an equitable way between permanent and seasonal population.

Moreover, the cost recovery objective justifies that small districts are more interested to establish the fixed part based on an individual basis (the flat when high seasonal fluctuations) rather than on a collective basis (like the meter or even the subscriber).

Finally, this objective explains why districts facing households with their own water try to cover sewerage cost through a flat rate pricing.

3.4.3. A structure to incite to consume water for outdoors uses.

A frequently observed structure is the declining block rate (*Figure 2*), which provides incentives to consume water rather than to save it. However, since the median volume of the first block is 200 cubic meters, the second block is only used by households living in detached houses with gardens (and swimming pools). 'Green' tariffs proposed by one third of the French districts (no sewerage part charged for outdoor uses, metered separately from indoor uses) are also implemented to increase the total volume of water sales and increase cost recovery.

Some concrete examples suggest that this type of pricing structure is chosen when water and wastewater network has been over-dimensioned, by anticipation of future water demand increase. It may also be implemented to reduce the profitability of alternative individual water supply strategies that households tend to develop when mains water is too expensive – in particular private boreholes construction (Montginoul, *et al.*, 2005).

On the contrary, none of the districts consulted have implemented a seasonal water pricing, a structure that can reduce water demand during peak periods and allow significant investment savings as network do not have to be oversized. This can be explained by the technical difficulties of implementing this structure in practice, in particular the need to read meters at least twice a year at the exact time of the rate change. Moreover, it must be understood by consumers to really reduce peak demand. A seasonal pricing can also cut peak consumption only if water demand is elastic to price. And, seasonal consumers, like tourists, are often assumed to be less sensitive to water price that inhabitants. Finally, a seasonal price can incite inhabitants to switch to other types of water, like groundwater or rainwater, something interesting for the district in terms of infrastructure dimension but dangerous in terms of water resource balance.

4. CONCLUSIONS

This study points out the fact that current water and wastewater pricing structure is mainly explained by the past and by the objective of covering costs, at least the "supply cost" which is recovered, for urban water, at a level of 96% in the Seine-Normandie river basin (Fredefon and Laurans, 2004). That is why the two-part structure dominates and why declining block rates are frequently implemented, particularly in small

districts. This statement is however not true for the indirect costs which are (partly) covered by Water Agencies taxes with a volumetric rate structure (except for districts without water meters).

If the new French water law proposal of May 2006 is voted following the WFD trends, many districts will have to adapt their pricing structures to generate more incentives to save water (increasing block rate, seasonal prices when high population fluctuations, etc.), in particular in water scarce areas. This change will not be easy to implement, especially when users (households, industries, etc.) have an access to an alternative water resource such as private tube-wells or rainwater recovery systems (Montginoul, *et al.*, 2005). If the new water law proposal compels these users to install meters, it seems also necessary to incite water users to save all type of water (included "alternative waters" and in particular groundwater) and not only water from public water network.

Acknowledgments

The author is grateful to Gabrielle Bouleau (Cemagref,) Jean-Daniel Rinaudo (BRGM) and the two anonymous reviewers for their detailed comments. This work has benefited from the financial support of the French Ministry for Ecology and Sustainable Development.

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