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Water price, price elasticity and the demand for drinking water

G. E. Achttienribbe, *VEWIN, Vereniging Van Exploitanten Van Waterleidingbedrijven in Nederland, Sir Winston Churchilllaan 273, Postbus 70, 2280 AB Rijswijk, Netherlands*

ABSTRACT: This article discusses the limitations in applying the price elasticity concept to drinking water. According to several studies, drinking water demand is mainly dependent on the capacity of water-using appliances (washing machines, toilets) and industrial installations. The replacement of such appliances seldom takes place directly after a price rise, but much later when they are worn out. However, the industry does react to price rises for drinking water by developing appliances that use less water. Unfortunately, this cannot be shown by conventional price elasticity studies as they rely on a direct and immediate reaction to changes in price.

INTRODUCTION

Water saving in order to promote a sustainable growth is high on the agenda of water companies in many countries in Western Europe. The methods to reduce water demand are restricted, especially changing the levels of water tariffs, since there is doubt as to the effectiveness of price as a disincentive.

These doubts result from research on the price elasticity of demand in Western Europe. It indicates that for household demand the elasticity is about -0.1. This means that a rise in prices of 10% reduces the demand by 1%.

Although there are only a few investigations on the price elasticity of industrial demand, the results are more encouraging with a price elasticity of about -0.3. On the other hand an investigation carried out in Rotterdam in 1976 did not indicate any significant price elasticity could of demand.

Because of the development of a water saving programme by the Netherlands Drinking Water Industry, a thorough investigation of household water demand took place in 1992 and 1995. The results of this investigation raise doubts about the usefulness of the price elasticity concept as a method of judging the effectiveness of the price variations to influence the demand of household drinking water consumption.

INVESTIGATION OF HOUSEHOLD WATER CONSUMPTION IN THE NETHERLANDS

Household demand expressed as litres per head per day of the population (L/h/d) rose in the period 1970–1992 by about 35%, to 135 L/h/d. In the same period, the average price of household drinking water tripled (30% in real terms). As about 80% of the water supplied was metered per household it was obvious that besides the price of drinking water, other factors exercised an enormous influence on demand. As the number of dwellings grew by 57%, and the average number of occupants decreased from 3.4 to 2.6 persons, it was often assumed that the decrease in occupants was responsible for the rise in total demand. This explanation is not satisfactory, as the use of drinking water is closely related to individual consumption and only a small part is related to the household itself. Alternative hypotheses were developed.

One of them was the improved quality of houses and a higher standard of living. A large number of the houses were new and because of the availability of natural gas they were all equipped with central heating and showering and bathing facilities and of course water flushing WCs. Moreover, increasing wealth enabled the population to buy washing machines. This hypothesis was investigated further. To this end, a marketing company, NIPO, was asked to investigate household demand together with VEWIN (the Netherlands Waterworks Association).

A census was carried out on 2000 families (1995). It showed an average consumption of 134.1 L per head and day (L/h/d) (Table 1).

It can be noted that 83.4% of total consumption is attributed to bath, shower, toilet and washing machine.

Table 1 Total water consumption

	L/h/d	%
Bath	9.0	6.7
Shower	38.3	28.6
Wash basin	4.2	3.1
Toilet	39.0	29.1
Hand washing	2.1	1.6
Washing machine	25.5	19.0
Dish washing (hand)	4.9	3.7
Dishwasher	0.9	0.7
Food preparation	2.0	1.5
Other	8.2	6.0
Total	134.1	100

Table 2 Water consumption attributable to showering

Age range (years)	L/h/d
18–25	52.45
25–34	50.21
35–44	41.74
45–54	36.33
55–64	29.65
65+	29.39

It is obvious that at least an important part of the growth originates from these uses and effective water saving measures should concentrate on them.

The investigation made clear that young people use much more water for showering (Table 2).

It showed that young people had showering patterns which markedly deviate from older people. This is caused by the fact that they have established a tradition in showering whereas older people have not. The same goes for the use for washing (Table 3).

Again it is obvious that the habits of young people familiar with washing machines differ markedly from older people's.

One may conclude that the rise of consumption in the period from 1970 to 1995 can be attributed to the better quality of the housing and the wider availability of bathing facilities and washing machines and that this force exceeds the influence of the price. Moreover, the level of consumption depends on the consumption capacity of water using devices.

This conclusion agrees with other findings. In Scandinavia, Switzerland and North Italy water consumption is traditionally much higher than in the Netherlands. It is likely that the wealth together with a rough climate and moderate energy prices in these countries promoted high quality houses with bathing facilities much earlier than in, e.g. the Netherlands. In the USA water consumption exceeds the European levels by far. This can at least be partly attributed to the capacity of water using equipment (toilet $\pm$ 20 L to 8 L in Europe, washing machines 150 L per wash to 100 L in Europe).

Table 3 Water consumption attributable to clothes washing

Age range (years)	Machine	Hand
18–24	23.36	5.8
25–34	26.18	5.64
35–44	27.30	5.57
45–54	26.47	7.96
55–64	24.73	11.23
65+	22.45	14.58

This does not mean that a population, which has the facilities mentioned above does not economise on the use of them when prices rise. But this seems to be the case. The equipment itself is expensive compared with the price of water and is used partly in combination with comparatively expensive energy and soap (washing machine). An average shower in the Netherlands takes about 60 L a time. At a price of NLG 3.00/m^3 this water costs NLG 0.18 (NLG = Netherland Guilders). A 20% rise in price of water means that the cost of showering rises by NLG 0.036; an amount of money that will upset only a few people. Apart from the toilet and the washing machine (20% price rise means: NLG 0.005 per flush and 0.06 per wash) the quantities needed for other uses are even smaller so the effect of a price rise will be even more limited.

Therefore one cannot expect the population to adapt its habits because of a price rise even if it is steep, especially as the price of drinking water is only a small part of the total costs of the use of the facilities (the bathroom and washing machine itself included). This conclusion coincides with another finding of the VEWIN NIPO investigation of 1995. When asked whether one would economise on water consumption if the price rose by 100%, 50% of the population answered they would not, whereas 38% said they would just a little bit. It must be mentioned that the use of water outside the house (gardening, swimming pools) is very limited in the Netherlands. It cannot be excluded that for these purposes some price elasticity could be shown.

The perception of the price incentive

Up to now we have concentrated on the use of drinking water. To judge the effectiveness of the price variable one has to discuss this price variable too.

In the Netherlands, as well as in the majority of the EC countries, water meters (as far as they are used) are read once a year. This meter reading is spread over whole year. As a price rise of drinking water seldom attracts the attention of the press it means that consumers are confronted mostly once a year with the price and price rise of drinking water when they receive and pay their bill. (In the Netherlands about 70% of household drinking water bills are paid automatically without any action of the customer. A general mandate is given once when closing a contract with the water company.) This confrontation takes place not at the moment that the price rise is executed but on the average half a year afterwards. It is not certain that the person handling the bill is unhappy with the price rise, but if it is the case and if he communicates it to the other occupants, their reaction will be uncertain, especially as water consumption for bathing and showering and using the toilet is a very individual activity.

One may safely conclude that at least with respect to household demand price-elasticity is difficult to demonstrate.

The shortcomings of the price elasticity concept and its meaning for water pricing

As price elasticity has to show the influences of the price only excluding all other influences on demand, one has to correlate the price with consumption the year following the rise. As we have seen a large number of the population will not receive notice of the price rise and if they do it will be on the average half a year later.

It is unlikely that consumption changes in the following year can be exclusively attributed to the price change because of changing circumstances.

This does not mean that price has no influence on the demand of drinking water, but it is probable that this connection cannot be demonstrated by the common elasticity investigations.

As we have seen before, household demand is very dependant on the availability and capacity of water using equipment and the age of the users. Although it is likely that price changes have little influence over the behaviour of the consumer towards water consumption—the effect is too small—it could influence the quantities of water, household and industrial installations use. Only this reaction is not immediate but could take place if equipment is replaced and provided there are less consuming alternatives. Due to the strong increase in drinking water prices and water saving programmes induced by a changing attitude towards the environment, the water industry in Germany has reduced the capacity of the washing machines of 100 L per wash to about 60 L, whereas and introduced toilets using 6 L per flush instead of the usual 9 L. Although people will not replace their equipment with these water saving alternatives immediately, they will be aware that water has a price and possibly they will expect the price to rise. If so, when they have to replace their equipment they will prefer to use water saving systems. As long as the price of water contributes to this attitude by both equipment manufacturers and consumers, the price will exert an important influence. Although it is not possible to separate the price from other variables such as environmental awareness, one can safely assume that the price itself and not the changes in price contribute to the reduction of water demand.

Price elasticity industrial demand

So far we have not discussed the meaning of price for industrial users of water. We mentioned an investigation in Rotterdam of 1976 which did not reveal any price-elasticity.

In 1973 a volumetric purification tax was levied in this area. This tax raised the price for the use of drinking water. It did not influence industrial water consumption directly but between 1976 and 1979, industrial demand for drinking water had decreased by 6%. It is probable that the water industry did not adapt its installations for the use of drinking water directly but combined the adaptation with other changes in their installations. If the price exerts an influence its effect is delayed and therefore will not be discovered by the usual elasticity studies, which concentrate on an immediate reaction. Thus the influences of the tax were difficult to discover. During the same period the quality of the drinking water supplied by the Rotterdam Waterworks improved dramatically. Since a large part of this water was used for boiler feed water, the use of water for flushing of the ion changers to prepare boiler feed water decreased, so did demand for drinking water. Finally, because of the rising energy prices in that period, the demand for water could be supposed to decrease as one economised on the use of the energy contents of the boiler feed water. Another factor which works against the use of the price elasticity concept for industrial demand is the quantity that industry uses. In most cases industrial supply of drinking water involves supply to a restricted number of very large customers as well as a number of smaller customers. The reactions of the small number of very large customers dominate industrial demand. As a result the elasticity industrial demand is dominated by the reactions of these very large customers which in their turn could be influenced by changes in production technology or in output caused by the demand for the products they supply.

CONCLUSIONS

Although the price elasticity concept is useful to show a general relation between the water price and water demand, its not possible to predict the change in demand caused by a certain price rise, at least in the Netherlands and comparable countries in Western Europe. Metering and volumetric water prices are useful to prevent spilling of water and to promote the use of equipment using less water.

For industrial water consumption the effect of a price rise can be expected to have a greater influence. It is difficult to calculate price elasticity as the effects will be seen years later. Moreover, the influence of other factors besides the price make it difficult to attribute the change in demand exclusively to price change.