Market-driven pricing structures for drinking water

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Abstract In the Netherlands, water company sales are being driven down by water conservation measures adopted in households and by the emergence of feasible alternatives to mains water. Because the cost structure is largely fixed, prices are rising as a result. These developments are at odds with the community responsibility which water companies bear in their capacity as quasi-monopolists in relation to those of their customers who do not have access to alternative sources. A number of water companies are therefore working on new pricing structures with which they are seeking to stabilise their income and to reduce the financial appeal of switching to substitutes for mains water. At the same time, incentives designed to ensure sparing use in the consumer market should not disappear. Waterleiding Maatschappij Limburg is working on two new pricing structures. A cost allocation method has been developed for bulk users which can be used as a basis for setting customer-specific water tariffs. In addition, a generic structure is being developed to boost revenues from standing charges. More than previously, this structure makes earnings more dependent on the supply capacity installed on a customer’s premises. In this article we discuss the background to these new structures and our initial experience. These pricing structures can also be employed in situations and countries where no noticeable reduction of sales has occurred yet, in order to keep ahead of the developments that are sketched here.

Keywords Capacity tariff; competition; differentiated tariffs; drinking water price; product policy

The Dutch drinking water market

The Dutch water market is served by 13 regional companies, owned by regional and local public authorities. Every year these companies supply 750 million m$^3$ of water to 16 million people in 7 million households. They also supply 500 million m$^3$ to companies and institutions, largely through 500,000 connections with a greater capacity than the standard for households. Of the sources used for the production of drinking water, groundwater accounts for 60% and surface water for 40%.

Competition

Each company has a regional monopoly for the supply of water through the mains distribution system. However, customers are at liberty to obtain water for their own use (domestic or industrial) through different avenues. In this text, with the term ‘alternative sources’ we refer to all water not supplied by the mains distribution. For example: private groundwater abstraction or surface water purification by reverse osmosis. The technological potential for this is developing rapidly and proprietary sources are coming within reach of a growing group of customers. This applies to both industrial bulk users and, for example, medium-sized cattle farmers and even for some categories of consumers.

Income and expenditure

Water companies are capital-intensive businesses. Approximately 80% of their expenditure must be treated as fixed and independent of the actual volume supplied. Income, on the other hand, is largely variable. Traditionally, these companies source 80 to 100% of
their income at a rate for each cubic metre purchased. This imbalance in the structure of income and expenditure creates a financial vulnerability to any decline in sales. Sales do actually decline owing to the growing role played by alternative sources and because domestic water savings are only partially offset by population growth.

Social duty
The drinking water companies are not allowed to exploit their monopoly in economic terms. They bear a social responsibility for the supply of qualitatively good drinking water for a reasonable price, especially to those customers with limited or no access to alternative sources. Combined with their cost structure, declining volume is pushing up prices. Encouraging greater consumption is socially undesirable for ecological reasons and is therefore not an option. The remedy must therefore be sought in a more effective competitive position in relation to alternative sources of water.

Waterleiding Maatschappij Limburg
Waterleiding Maatschappij Limburg (WML) is a water company of average size by Dutch standards. WML serves the southern province of Limburg, representing approximately 7% of the consumer market (53 million m³/yr to 480,000 households). Its sales to the business market (23 million m³) are relatively limited but vitally important in commercial terms. WML’s share of the regional market is approximately 45%. The pressure on sales volumes referred to above is also being felt in Limburg. With a 90% variable earnings structure, there is a danger of upward pressure on prices with the potential for an accelerated decline in volume as a result.

The problem
The declining trend in the per capita domestic consumption of water must largely be viewed on its own. For this reason, ways of safeguarding sales volumes must be sought in the extension of market share against alternative sources, especially in the non-domestic segment of the market. One of the tools that may be employed is an adjustment of the pricing structure. WML is seeking to establish a commercially prudent pricing structure which is appropriate to its social and ecological responsibilities.

New pricing structures
WML has developed two pricing structures in recent years. One specific and the other generic, both can be employed in the market alongside each other. The specific structure, intended for major customers, is a proprietary development of WML. The generic structure is based on principles which the Dutch water companies have developed and selected together (Van den Burg and Geudens, 2004). Several other companies already acquired experience implementing these principles (Couwenberg, 2002). In the rest of this article we describe several background aspects to pricing structures in general. Next, we consider the structures that were current in the Netherlands until recently. Then we deal with developments at WML. We end with several conclusions about the effects and feasibility of these structures.

Background to drinking water pricing structures
Although the concept of ‘scarcity’ hardly seems to play a role in the Dutch situation, water is considered to be a relatively scarce economic commodity. However, the criterion of ‘economic efficiency’ alone is inadequate for the purposes of water distribution. In addition, the criteria of ‘social justice’ and ‘ecological sustainability’ must also play
a role in a practical and practicable manner (Meijerink and Ruijs, 2003). A water company needs to take these criteria into account in its pricing policy.

**Tariffs and buying patterns**

Far from all customers make conscious decisions about their consumption of water, about the costs and implications involved, and about the use of alternative sources of water to that supplied through the mains. Many domestic and corporate customers in the Netherlands consider the availability of drinking water and the price paid for it as irrefutable givens. Their understanding of the actual price of water and the amount of their annual account is limited. Large customers who are consciously looking at possible alternatives make decisions predominantly on commercial grounds.

Within the Dutch context, the criterion of ‘social justice’ is satisfied, if a pricing structure is based on the principle of ‘user pays’. For practical reasons, this principle may be rendered subordinate to that of solidarity. A tariff based on solidarity means that within similar categories of customers and products no distinction is drawn on the basis of specific individual circumstances.

**Elasticity of prices**

Opinions and facts diverge in relation to the sensitivity of domestic water consumption to pricing. In the Netherlands, tariffs do not have any apparent impact on consumption. Prices differ substantially from one region to the next (up to 60%), yet there is no demonstrable difference in usage per region. It has been shown however (Dalhuisen, 2002) that clearly discernible, abrupt tariff-related measures may result in a more conscious use of water. Billing based on metered consumption is more effective than a fixed subscription fee. A batch rate, involving a higher price for water above average consumption, could have an identical impact. Metered connections are the standard in most regions and are gradually being introduced in other regions. There does not appear to be any support for a batch rate in the Netherlands.

**Pricing and ecology**

The positive ecological effects of higher water prices are therefore easy to overestimate. Water-saving equipment is not installed after a change in tariffs but when it is opportune to do so: when the washing machine is replaced or bathroom facilities are upgraded. Higher variable rates may induce large groups of corporate and domestic customers to resort to alternative sources. This frequently takes the form of proprietary groundwater abstraction, with the result that the net ecological outcome is probably negative. Because a water company’s expenditure only drops to a limited extent when sales volumes diminish, such developments may result in a decline of prosperity (Aalbers et al., 2000).

This risk becomes even more acute, if water tariffs also include sewerage and water purification fees. The further extension of variable pricing is constantly cited as one of the options in the regularly recurring discussions about ‘water chain tariffs’. Nevertheless, sewerage and water purification costs hardly depend on the consumption of drinking water (Van den Burg and Stumphius, 2003). Within the Dutch situation the criterion of ‘ecological sustainability’ is adequately satisfied, if connections are metered and tariffs contain a clearly defined variable component. There is no reason why this variable component should be increased as much as possible.

**Existing pricing structures**

Every water company has its own pricing structure. The latter differs in respect of both the structure itself and the amounts involved. Different price levels can largely be
explained through the quality of the sources and infrastructural cost factors, such as the nature of the soil and building density. In most cases structural differences may be viewed as ‘variations on a theme’. In 1980 and 1993 attempts were made to develop a uniform pricing structure for the industry. Few companies adopted all of the relevant proposals, although many extracted elements from them and incorporated them into their own structure. In all cases the underlying premise sought to spread the cost of producing and supplying water amongst customers as effectively as possible. In addition, an attempt was made to produce as great an incentive as possible to reduce water consumption. The bulk of the costs were therefore passed on in the form of variable tariffs. Any differentiation of these volume-based rates did not occur or only to a limited extent.

Implications

A predominantly variable pricing structure is costly, particularly to larger customers. The costs of alternative sources are largely fixed. For a bulk customer, it is simple to calculate the optimal financial solution. Another category of customers, some having rather substantial connections, do not purchase water or hardly any at all. Although considerable costs can be allocated to such customers, they hardly generate any sales. Even many of those who utilise alternative sources maintain their connection to the water mains in case of an emergency. These customers represent a loss to a water company.

Some of the principles underlying the ‘old’ pricing structures continue to apply as part of the new approach. For instance, a financial incentive to use water sparingly must be maintained, even if one seeks to ensure that it is adequate rather than as large as possible. Also, there is an ongoing effort to spread expenses amongst customers as fairly as possible. One-off services (for example, installing new connections, administrative relocations or consultancy) are increasingly billed separately, with the result that the standard tariffs only need to cover the cost of sales, production and supply.

A specific structure for major customers

In 2002, the corporate consumption of water in the province of Limburg, which is not supplied by WML, was estimated to amount to 102 million m³, far more than the total volume which the company supplied. This market segment includes a number of potential major WML customers. In the course of time more than 50% of the businesses active in the agricultural sector installed their own water abstraction facilities, which led to a fall-off in sales of several million cubic metres. It was therefore high time for WML to become actively involved in finding solutions.

Together with the University of Maastricht, WML developed a cost allocation model (Van de Klundert, 2002) making it possible to optimise its result in this market segment. This model, “InGrid”, is used as an extension of its existing pricing structure. It uses demand functions which indicate what additional volume of sales can be achieved by offering specific customers reduced, ‘differentiated’ tariffs. Offering lower prices is justified, if this actually yields an increase in volume or if it ensures that existing customers do not switch to their own water supply. In these cases the solidarity principle works the other way round: it is then in everyone’s interest to draw a distinction based on individual circumstances.

Not only do differentiated tariffs need to cover variable costs, they must also make a substantial contribution to covering fixed expenses. The marginal costs of supplying volume to a new customer partly depend on the measures that need to be adopted in order to supply him. The differentiated tariffs that are agreed are always well above the level of these marginal costs but are less than the current water price of 1.36 €/m³.
The prerequisite for such lower tariffs is that the volume which is to be procured, the term and the indexation of prices are stipulated in a contract.

Publicity plays a major role in this respect. How do you reach customers who pose a risk and what do you tell those who are not eligible for lower tariffs? WML employs account management to ensure that bulk users are approached personally. Small-scale customers who pose a threat in the form of reduced sales are approached using direct mail. In our communication with other customers we point out that differentiated tariffs for specific customers are ultimately in the interests and to the benefit of all of them.

Experience with the commercial utilisation of this model led to the following results in 2003 and 2004. Following lengthy negotiations WML managed to enter into a supply agreement for 10 years with the company responsible for the single largest amount of proprietary abstraction (600,000 m³/yr) in its supply area. It also managed to prevent a business consuming 300,000 m³/yr from switching to an alternative source. In addition, contracts were concluded with approximately 150 largely agricultural enterprises to ensure long-term sales retention. As a result, total sales only increased by a small percentage but the implications for our fixed cost cover are considerable. Apart from cost management measures, differentiated pricing has ensured that there has been no need to raise tariffs for all our existing customers in the past two years even though inflation amounted to 2.7% on average.

A new generic pricing structure
Although the use of customer-specific discounts is highly effective, there are several practical obstacles standing in the way. The risk that a customer may opt for an alternative source of water needs to be acknowledged and assessed in each case. The water company then has to enter into negotiations with each customer to agree on a tariff. It needs to be able to reject claims from other customers demanding discounts, citing firm grounds for doing so. In order to address these practical obstacles WML is looking for a generic structure which will produce an identical outcome, albeit for a more wide-ranging group of customers. Moreover, this has been tied to the aim of substantially boosting the amount of earnings which standing charges account for, so as to reduce WML’s financial vulnerability. The key aspects of this new structure, which is currently being developed, are described below.

A new product policy
The new pricing structure is based on a fresh approach to the water company’s products. The traditional view holds that only one primary product is supplied, namely, drinking water. All endeavours and investments were viewed as a means to produce and supply drinking water. All the costs involved were allocated to purchasers of the product known as drinking water.

The new approach involves two primary products. Besides drinking water, delivery capacity is to be introduced as a product as well, which is also referred to as a ‘connection’. After all, customers demand the guaranteed, uninterrupted availability of water 24 hr/d, even if they only use it sparingly. We even have customers who do not purchase any water but who do demand ongoing availability, in some cases even a substantial potential supply. Consider those customers who maintain a connection for fire-fighting purposes (sprinkler systems), or those companies that have installed their own water supply but maintain a connection with the water mains as a back-up source. An average household in the Netherlands consumes 103 m³/yr (VEWIN and NIPO, 2005) and has capacity to accommodate supply at the rate of 1.5 or 2.5 m³/h. Less than 1% of available
capacity is therefore used to supply water. The average utilisation rate of the larger connections is somewhat higher, between 2 and 4% in the case of most water companies.

**The cost of the product, capacity**

In principle, the capacity of a connection is geared to the peak consumption which the relevant customer can ever expect. A water company must be ready at any time to supply water up to the maximum capacity of those customers who demand this. Costs are therefore incurred in order to provide capacity even if no water is supplied. More importantly, a reduced or irregular flow in parts of the distribution system will produce risks pertaining to quality: stagnant water, subsidence and the release of deposits. Those customer connections which are not used to supply water, or only at excessively irregular intervals, therefore generate additional operating expenses in the form of quality checks and distribution system flushing. This line of reasoning provides justification for insisting that customers help cover their water company’s costs based on their connection capacity. This contribution will reduce the price of water, thereby compensating those customers who purchase above-average quantities of water. A pricing structure incorporating a large fixed component which depends on capacity, and lower water tariffs, will produce a more equitable allocation of costs to customers.

**Breakdown of cost of drinking water and capacity**

The costs incurred by a water company, less any income from services which are billed separately, must be spread over the product categories. All primary business processes make a contribution to the creation of both products, although the allocation of costs may differ in respect of each process. Overheads are distributed amongst the primary processes. Table 1 presents a fictitious example of such a distribution. It is customary for the capacity product category to account for 30% to 35% of expenditure.

The key for the breakdown of the operational processes is based on the ratio of available to required capacity. Production costs are largely allocated to water. Overcapacity designed to absorb supply peaks accounts for a small part of the total. Of the capacity available in the high-density part of the distribution system and the connections, only a very small proportion is used to supply water, which is reflected in the breakdown of operating expenses. The allocation to the transport and primary distribution system can be found between these two extremes. The sales process consists of a number of subsidiary processes involving varying allocations. This has a limited effect on the overall breakdown.

**Breakdown of expenses over capacity classes**

Costs are allocated to the various types of connections based on the capacity reserved by customers. This capacity may be determined in technical terms or on the basis of an agreement. Where an agreement is concerned, a means of verification is required.

**Table 1 Example of the breakdown of costs by product type**

<table>
<thead>
<tr>
<th>Processes</th>
<th>Costs (€/m)</th>
<th>Breakdown by product type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drinking water</td>
<td>Capacity</td>
</tr>
<tr>
<td>Production</td>
<td>54</td>
<td>90%</td>
</tr>
<tr>
<td>Transport and primary distribution</td>
<td>10</td>
<td>60%</td>
</tr>
<tr>
<td>Distribution and connections</td>
<td>22</td>
<td>5%</td>
</tr>
<tr>
<td>Sales</td>
<td>14</td>
<td>65%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>65%</td>
</tr>
</tbody>
</table>
Exceeding the agreed capacity would then constitute grounds for revising the agreement with retrospective effect. There would be no reason to proceed with settlement, if any reserved capacity were not utilised. Reservation generates expenses and not any actual peaks if they fall within the scope of the agreement.

The allocation formula is based on the principle of equivalent connections. It is a statistical given that customer peak consumption only coincides to a limited extent, with the result that less capacity needs to be reserved for a group of connections than the sum of the individual reserves. It follows from this that the costs to be allocated to a connection achieve a faster than linear increase expressed as a function of capacity. The following is a usable formula for calculating the proportion of capacity-related costs:

\[
\frac{\text{Costs}_x}{\text{Costs}_y} = \left(\frac{\text{Capacity}_x}{\text{Capacity}_y}\right)^{1.4}
\]

In this formula, \(x\) and \(y\) represent two connections with varying capacity; the exponent, 1.4, determines the increase of the allocated costs. Table 2 presents an example of several equivalent outcomes.

### From cost allocation to pricing structure

The formula for calculating the proportion of capacity-related costs can be translated into one for determining the annual standing charges as follows:

\[
\text{Standing Charges}_x = B + L \times \left(\frac{\text{Capacity}_x}{1.5}\right)^{1.4}
\]

Here, \(B\) represents charging a basic amount which is independent of capacity, in the case of each connection; \(L\) represents the amount per equivalent unit which is required to generate the total turnover required in the case of the capacity product category, like for example 35% of total revenues. The increase of the standing charges creates scope for a reduction of water prices.

Within this framework there are various alternatives to choose from. A company may decide not to introduce higher standing charges in the case of the smallest connections, or only to a limited extent. These will then continue to pay a higher price for water than the larger connections. A company may also opt for capacity-related differentiation of water tariffs by way of compensation for the exponential increase in the standing charges. Table 3 presents a fictitious example of a pricing structure in which \(B\) is equal to 30€ and \(L\) is equal to 50€ in the case of connections of 6 m³/hr or more.

The financial implications for customers will depend on their individual water consumption and differ greatly as a result. Customers with an average rate of consumption (compared with their capacity) will experience little advantages or disadvantages, while the changes may be substantial for other customers. Precise customer communication is required about the background and purpose of the new structure, when it is introduced.

| Table 2 | Equivalent units for connections with varying capacity |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Capacity (m³/h) | 1.5 | 2.5 | 6 | 10 | 15 | 40 | 60 |
| Equivalent units | 1 | 2 | 7 | 14 | 25 | 98 | 175 |

| Table 3 | Example of a generic pricing structure using standing charges based on capacity |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Capacity (m³/h) | 1.5/2.5 | 6 | 10 | 15 | 40 | 60 |
| Standing charges (€/yr) | 30 | 380 | 730 | 1,280 | 4,930 | 8,780 |
| Water price (€/m³) | 1.20 | 0.93 | 0.92 | 0.91 | 0.89 | 0.87 |
Table 4 presents examples of the consequences for some typical customers. The new structure is compared to a flat rate of 1.34 €/m³ plus 16 €/yr for all customers.

<table>
<thead>
<tr>
<th>Capacity (m³/hr)</th>
<th>Volume used (m³/yr)</th>
<th>Revenue (€/yr)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single person household</td>
<td>1.5</td>
<td>50</td>
<td>83</td>
</tr>
<tr>
<td>Average family</td>
<td>1.5</td>
<td>130</td>
<td>190</td>
</tr>
<tr>
<td>Small business</td>
<td>6</td>
<td>1,500</td>
<td>2,026</td>
</tr>
<tr>
<td>Back-up customer</td>
<td>40</td>
<td>300</td>
<td>418</td>
</tr>
<tr>
<td>Industrial user</td>
<td>60</td>
<td>40,000</td>
<td>53,618</td>
</tr>
</tbody>
</table>

Table 4 presents examples of the consequences for some typical customers. The new structure is compared to a flat rate of 1.34 €/m³ plus 16 €/yr for all customers.

**Implementation**

WML’s new generic pricing structure is still in development. Another water company, Hydron, has since acquired experience implementing it for about 12,000 customers with a large connection (Couwenberg, 2002). With the aid of judicious publicity, it managed to keep the number of negative responses and objections below 0.5%. Approximately 15% of its customers seized the opportunity to reduce the capacity of their connections. This effect had been anticipated when determining the new tariffs. In the future this will amount to operational savings for the water company.

Concrete results have also been achieved in relation to maintaining sales volumes. Special differentiated pricing was introduced: any company which contractually undertakes to use only Hydron water for at least four years receives an additional discount on the price of water of 0.12 €. Almost 700 mainly larger customers had their volume stipulated in a contract. Twelve agricultural businesses (dairy farms) ceased their own abstraction of ground water and switched to the mains supply.

**Conclusions**

Both the specific and generic pricing structure are capable of helping us achieve our aim of safeguarding sales volumes. The generic structure will make a major contribution to stabilising WML earnings by raising income from standing charges from 10% to approximately 30%. The new generic structure also moves further towards a more equitable allocation of costs to our customers, because it offers a solution for the losses suffered in respect of customers who purchase little or no water at all. The price reduction of water related to delivery capacity diminishes the need to lower water tariffs even further in the case of large volumes. Although the scope for a tailored approach may be narrowed, the option of providing specific discounts remains a meaningful addition, even to the generic pricing structure.

Both pricing structures retain adequate incentives to promote sparing consumption in the consumer market. The variable rate for small-scale customers has only declined to a limited extent or not at all. Both pricing structures will help WML to compete with substitutes for mains water. In principle, the new generic structure will do this across the board. While this may appear to be less efficient, it will prevent too many customers from advancing ‘me too’ arguments to claim discounts which cannot be justified when viewed in terms of expenditure.

Both pricing structures are based on generally applicable principles. On their own or together, we anticipate that it will be possible to use them in many situations, even outside the Netherlands.
References