# **Agenda** Advancing economics in business

# Ready, willing and able to pay? Applying cost-benefit analysis in the water sector

In its recent consultation paper for the forthcoming periodic review of prices, Ofwat states that water companies' business plans will have to be broadly supported by cost-benefit analysis. What will this mean for companies? This article sets out the key components of the CBA methodology, highlights potential issues that the water sector might face, and considers how CBA has been applied in other regulated sectors

When setting prices for regional monopolies, regulators have to decide which proposed capital projects companies should be allowed or required to undertake, taking account not only of the efficiency with which they are procured, but also whether they are in the public interest. Many of the projects proposed by companies have to be paid for through increased prices to customers, and, ultimately, the regulator has to strike an appropriate balance between increases in the level of service and higher prices.

In its consultation paper for the 2009 periodic review of prices (PR09), Ofwat, the regulator of water companies in England and Wales, has stated that it expects companies to take the lead in demonstrating that consumers are willing to pay for improvements in service proposed in their business plans by using cost–benefit analysis (CBA).<sup>1</sup> Even though CBA has been used in the water sector for some time (eg, in appraising measures to implement the Water Framework Directive<sup>2</sup>), this is the first time that a comprehensive CBA exercise is required directly from the water companies.

Using CBA may allow companies to influence the debate with the regulator on which capital projects should be undertaken by demonstrating how much consumers are willing to pay for the benefits obtained. Each company will set its own investment priorities according to consumer preferences, so consumers who are willing to pay for an improvement (such as flood defences) can receive the benefit, while consumers in other areas who do not value the improvement above the costs will not be required to pay.

CBA is a highly versatile methodology for assessing the social and economic impact of policy and investment decisions. It is predicated on the need to ensure that scarce resources are used efficiently. In competitive

markets, competition between firms ensures that investment decisions are approached optimally, but in markets in which competition is not possible as a result of market imperfections (eg, natural monopolies such as water distribution), economic efficiency is not achieved automatically, since customers' valuations are not revealed in prices. In such cases, CBA can help to ensure that decisions are taken that do indeed result in increased social welfare.

## How to conduct CBA?

The role and methodology of CBA in central government are summarised in the 2003 Treasury Green Book.<sup>3</sup> The objective of a CBA exercise is simple: quantification, in monetary terms, of the costs and benefits of potential projects. The decision rule of CBA is also simple: if net benefits exceed the expected costs, the project should proceed on the basis that it increases social welfare. However, implementing this apparently simple methodology has several complications.

Social welfare analysis is often carried out for projects undertaken by the private sector.<sup>4</sup> In such cases, the companies' and customers' costs and benefits become a key element of the CBA analysis. However, costs and benefits that affect the rest of the society (external costs or externalities), should also be taken into account. For example, a water pipe replacement project generates costs for the company (purchasing and installing the pipes), for the customers (traffic disruption outside their homes), and for the rest of society (traffic disruption when visiting the town in which the company is installing the pipes).

Some projects generate costs and benefits that cannot be translated into monetary terms by the utilisation of market values, simply because there might not be a market for some goods (or services). However, when



market values are not available, there are some quantitative techniques that make it possible to infer what the market value might be. Figure 1 shows the level of difficulty of measuring costs and benefits for companies, customers and society. Some of the issues that arise in calculating the costs and benefits are discussed below.

#### Costs

The calculation of direct costs associated with a project is usually straightforward since the majority of the costs are incurred by companies and there are market prices readily available (eg, market prices for pipes). However, care should be taken when calculating the compensation for risk. Private investments in projects driven by public policies can be risky, so private companies may require compensation for such risk, which could be added to the cost of the project. Oxera has developed a methodology to quantify risk compensation, which maintains that the level of compensation is necessarily related to the company's cost of capital, which is the return required by investors.

Where projects have uncertainty surrounding costs, consideration should be given to the likely range of possible costs and what impact these may have on the CBA. If a project still passes the CBA decision rule at the maximum possible cost, it should be undertaken since it is likely to be beneficial to consumers, even at the maximum cost. For projects where the range of possible costs overlaps with the estimated benefits, it is important to assess realistically the expected costs and to avoid the optimism bias highlighted by Lavello and Kahneman (2003),<sup>5</sup> for example, and the Treasury Green Book.

#### **Benefits**

The calculation of benefits for which market values are not available relies on a set of quantitative techniques that aim to determine the willingness to pay (WTP) for a benefit. The WTP can be estimated using revealed- or stated-preference techniques.

Revealed-preference techniques calculate WTP by analysing consumers' actual behaviour when faced with a choice. For example, how much a customer is willing to pay for peace and quiet can be inferred by analysing data on house prices and noise levels. Similarly, how much a customer is willing to pay for clean(er) drinking water may be deduced from data obtained from the water filter and mineral water markets. These techniques can produce reliable estimates of how consumers have actually behaved; however, they require a great deal of 'real-world' data, which may be difficult to obtain, particularly for projects of a kind that has not been undertaken before.

Stated-preference techniques calculate WTP by analysing a sample of consumer responses to a survey questionnaire.<sup>6</sup> The advantage of stated-preference techniques is that they can be used to assess hypothetical situations and more complex and abstract goods, such as improvements to water quality at recreational sites. However, these techniques have a number of caveats to be considered when conducting surveys and analysis. First, would people actually do what they say they would? For example, respondents may say that they would be willing to pay for environmental improvements, but if they were actually offered a choice of two water services-one with a higher price and corresponding lower environmental impact-would they actually opt for the more expensive? Second, neutrality in the presentation of information is key in guaranteeing unbiased results. Questions should be worded and scenarios described such that consumers are not led to choose a particular answer.

Furthermore, some benefits are easier for consumers to quantify than others (see Figure 2). Most consumers can see and value the benefits of improved consumer service, such as reduced response times to telephone enquiries. However, consumers may be less effective at valuing low-probability events, such as illness caused by poor water quality. Changes to low-probability events are difficult for consumers to understand and may be biased by recent events. For example, customers in an area that has suffered recent flooding may be more willing to pay for flood defences than they would have been prior to the flooding. While this may partly reflect an updating of the expectations of the future risk of flooding, it may also be the case that the stated WTP will diminish as the importance of the event fades in people's memories.

The benefits of any project need to be presented to consumers in a context that is clear and plausible. For example, reducing the amount of nitrate in sewage might mean little to a consumer until it is explained that it would increase the volume and variety of flora and fauna in rivers. Moreover, the nature and method of the payment needs to be described in a way that does not bias the answers. For example, payment to a charity may be more acceptable than to a corporation. Nevertheless, despite the various difficulties involved, these techniques offer a valuation method which can



provide useful information for CBA, as long as the inherent margins of error are recognised.

#### Discounting

The costs and benefits associated with any project may occur over different periods of time. Therefore, in order to compare them, they need to be discounted and expressed in net present value (NPV) terms. The practice for discounting has been to apply a social time preference rate (STPR) of 3.5% for the appraisal of public projects. For longer-term assessments, declining rates are used, where the rate of decline is defined in accordance with advice in the Treasury Green Book.<sup>7</sup>

Current guidance does not seem very clear as to whether 3.5% should also be used for appraisal of projects financed by the private sector. For example, the Treasury Green Book does not explicitly state that the STPR should be used for private costs.

Oxera research has looked into this issue, focusing on appraisals to be carried out under the Water Framework Directive. This research has shown that, with a few exceptions, the standard discount rate of 3.5% has been applied in CBA. The research also found that there appears to be agreement on the treatment of risks that need to be taken into account in appraisal. However, it is questionable as to whether the cost of risk should be included directly in the stream of costs to be discounted. as discussed above, or in the form of a higher discount rate. The methodology developed by Oxera suggests that the cost of risk should be included in the stream of costs when calculating the NPV of costs. The STPR should then be used as the discount rate. This treatment of risks is consistent with the Treasury Green Book, which also advocates adjusting the costs. In any event, care must be taken to avoid double-counting for risk.

# Potential issues for the water sector

#### **Distributional impacts**

Even though some projects might be socially beneficial (ie, benefits outweigh costs), they can create undesired distributional impacts. For example, affluent consumers may be willing to pay more than poorer customers for a given increase in quality. If all customers end up paying equal amounts, the well-off consumers will be paying below their WTP (and hence would be made better off as a result of the project), and deprived consumers will be paying above their WTP. The question in these cases is: to what extent are Ofwat and the water companies responsible for taking account of, or dealing with, distributional impacts that might arise as a consequence of different investment decisions?

There are methods described in the CBA literature that allow such distributional factors to be taken formally into account—for example, by placing different weights on the costs or benefits to different types of consumer however, these are contentious. In practice, distributional factors can perhaps be taken into account less formally, or outside of the pure CBA, as part of a wider policy to ensure that poorer consumers are able to afford good water service.

#### External benefits and non-use value

In many cases the benefits of a project are entirely appropriated by the customers, and the rest of the society does not benefit (ie, there are no external benefits). In such cases, it seems reasonable to elicit the value of the benefits of the project entirely from customer surveys.

However, for other water sector projects, especially those with a direct impact on the environment, a significant proportion of benefits will be available to the rest of society. In these cases, special attention should be given to non-use value. This is the value that customers are willing to pay for goods (and services) that they may never consume—eg, the value of improvements in the water quality of a river to an individual who does not visit the river. How to take the non-use value into account is subject to debate. However, the best option in some cases may be to include the results with and without non-use value in order to understand how this affects the net benefits.

#### **Benefits transfer**

Given the relatively high cost of undertaking robust stated-preference studies, a technique often employed in CBA is 'benefits transfer', where the results of studies of the same types of cost or benefit undertaken in different contexts and locations are used to infer the values in the case in question, after adjusting for systematic differences in income and other relevant factors. This can sometimes be applied in the water sector, but there are often factors that make this challenging. While WTP for improvements in water quality, for example, may be fairly well determined and vary systematically with individual socio-economic characteristics, impacts of emissions to water on amenity and non-use value can be very location-specific (eg, tidal estuaries differ from upstream locations). As a result, benefits transfer should be undertaken with caution in the water sector.

#### **Uncertainty about outputs**

Many water projects have an expected outcome, but if the project is a new one, there may be significant uncertainty surrounding its benefits. It is difficult for consumers to value the benefit of something which may or may not happen, and factoring in such uncertainty in a survey is likely to lead to bias. Instead, it is better to use the valuations for a variety of possible outcomes and calculate a range of expected benefits of the project using the different valuations depending on the outcome. It will then be possible to see what minimum level of improvement is needed for consumers to consider it worth paying for.

## **CBA** in other sectors

CBA has been used extensively in other sectors where the lack of a competitive market means that an alternative way to make decisions on capital investment programmes has to be found. One of the main proponents of using CBA has been the transport sector, where most large investments are subject to CBA to ensure that they are in the public interest. The UK Department for Transport has a well-developed appraisal tool which is used by both government and scheme promoters to help evaluate the net social benefits of new transport projects, and the recent Eddington Transport Study based much of its analysis and policy conclusions around measures of value for money derived from CBA, which is used routinely in the road and public transport sectors.<sup>8</sup>

Examples of CBA in transport include large-scale investment projects such as the London Crossrail project, the Mayor's Transport Strategy for London, as well as smaller and incremental changes such as introducing air-conditioning on trains and adding extra capacity to reduce crowding. The transport sector has developed tools for understanding the decision-making process of individuals, enabling them to value goods they cannot yet purchase through the use of revealedand stated-preference techniques.

Other examples of CBA in regulated markets include valuing the benefits to consumers from regulating taxi markets,<sup>9</sup> and of installing energy-efficient capital goods in consumers' homes and the implications for subsidies.<sup>10</sup> CBA has been also used to:

- estimate the costs and benefits associated with the publication of real-time information on flows of gas into the GB national transmission system;<sup>11</sup>
- support the assessment of the impact of a 'minimum price rule',<sup>12</sup> and
- assess the benefits of financial regulation.<sup>13</sup>

### **Concluding comments**

CBA is an important tool for assessing the impact of government decisions. Government agencies and regulators are increasingly obliged to undertake CBA-type studies and to justify their decisions on the grounds of economic efficiency. It has become clear from the PR09 methodology consultation that Ofwat is taking its duty of care to consumers seriously by asking companies to prove that their consumers are willing to pay the extra increase in bills for the proposed improvements.

Conceptually, CBA can be used to assess whether consumers are willing to pay for certain improvements to their service where a market does not exist. In practice there are several issues to be tackled, such as clearly explaining the benefits to consumers, considering the distributional impacts of the projects (who pays and who benefits), and dealing with uncertainty surrounding the possible costs and benefits. Many of these issues have been addressed in other industries where CBA has been used for some time, and there are likely to be lessons from the experience of these other sectors which will help to ensure that CBA provides reliable evidencebased analysis of consumers' WTP for improvements to the service. <sup>1</sup> Ofwat (2007), 'Setting Price Limits for 2010–15: Framework and Approach—A Consultation Paper', October.

<sup>2</sup> Oxera (2007), 'Cleaning Up Our Act: What Now for the Water Framework Directive?', Agenda, August.

<sup>3</sup> HM Treasury (2003), 'The Green Book: Appraisal and Evaluation in Central Government', January.

<sup>4</sup> CBA can also be used to assess market regulation. See Oxera (2004), 'Costs and Benefits of Market Regulators', report prepared for the Dutch Ministry of Economic Affairs, October. Available at www.oxera.com.

<sup>5</sup> Lavello, D. and Kahneman, D. (2003), 'Delusions of Success: How Optimism Undermines Executives' Decisions', *Harvard Business Review*, July.

<sup>6</sup> See Bateman, I.J., Carson, R.T., Day, B., Hanemann, N., Hett, T., Hanley, N., Jones-Lee, M., Loomes, G., Mourato, S. and Ozdemiroglu, E. (2002), *Economic Valuation with Stated Preference Techniques: A Manual*, Edward Elgar.

<sup>7</sup> This advice was based in part on the Oxera report, 'A Social Time Preference Rate for Use in Long-term Discounting', prepared for the Office of the Deputy Prime Minister, Department for Transport, and Department of the Environment, Food and Rural Affairs, December 2002. Available at www.oxera.com.

<sup>8</sup> See http://www.webtag.org.uk/. Department for Transport (2006), 'The Eddington Transport Study', December.

<sup>o</sup> Oxera (2003), 'Modelling the Effects of Taxi Regulation' and 'Consumer Survey Report', reports prepared for the Office of Fair Trading, November. Available at www.oxera.com.

<sup>10</sup> Oxera (2006), 'Policies for Energy Efficiency in the UK Household Sector', report prepared for the Department of the Environment, Food and Rural Affairs, January. Available at www.oxera.com.

<sup>11</sup> Oxera (2005), 'What are the Costs and Benefits of Near Real-time Gas Information?', report prepared for UK Offshore Operators Association, May. Available at www.oxera.com.

<sup>12</sup> Oxera (2005), 'What is the Impact of a Minimum Price Rule?', report prepared for the Dutch Ministry of Economic Affairs, June. Available at www.oxera.com.

<sup>13</sup> Oxera (2006), 'A Framework for Assessing the Benefits of Financial Regulation', report prepared for the Financial Services Authority, June. Available at www.oxera.com.

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