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THE WELFARE COSTS OF NON-MARGINAL WATER PRICING: EVIDENCE FROM THE WATER ONLY COMPANIES IN ENGLAND AND WALES

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Abstract

The evaluation of the economic efficiency of regulatory schemes is essential for regulators and utilities. In this study it is analysed for the first time the welfare costs of the regulation in the water supply in England and Wales, by computing the deadweight loss of the water only companies (WoCs) that existed over the period of 1993-2009. The results indicate that the current regulation can have substantial efficiency costs. Our estimates show that the loss of efficiency for the WoCs lies between 15 and 60 million GBP over the period 1993-2009. These amounts could have been redistributed either to the companies in terms of profits or to the consumers via price reductions. The methodology and results of this study are of great interest for both regulators and water utilities managers to evaluate the effectiveness of regulation and make informed decisions.

Keywords: profits; deadweight loss; water industry

1. Introduction

Water and sewerage services are usually provided in monopoly regimes. Hence, as other network industries, the water and sewerage industry in many countries is regulated following different approaches (Worthington, 2014; Molinos-Senante et al. 2015). As water supply is a large market covering more than 99% of the population, the potential welfare effects of prices set at levels that do not represent the cost of production are potentially important. Apart from transfers between consumers and producers, the pricing of a good can lead to a deadweight loss, i.e. a loss of economic efficiency in monetary measure that can occur when the consumer price is not equal to the marginal cost. This question is all the more important as regulation of utilities has been questioned over the last thirty years as several network industries that evolved historically as state-owned enterprises have been privatized (Zhang et al. 2015).

Regulators can define models of pricing to avoid a loss of economic efficiency. In the ideal case, regulators are completely informed about the costs of the firm and consumer demand elasticities so they can define second-best pricing to ensure a balance budget constraint for the firm and to avoid a deadweight loss (Boiteux 1960). Because of this lack of information, regulators have to define incentives – such as price-cap schemes – to ensure cost-reduction and consumer access to goods which often have public service characteristics. In this framework developed by Laffont and Tirole (1993) among others, firms want to convince the regulator that they have higher costs than they are actually, in order to have price-caps higher than their cost of production[1] and can capture profits. It creates a deadweight loss from prices that are too high. Under this fixed-price regulatory contract, firms have incentives to fully exploit their cost opportunities by exerting the optimal amount of effort to decrease their cost of production and increase their margins.

Focusing on England and Wales, after the privatization process of the water industry in 1989, the Regional Water Authorities formed the water and sewerage companies (WaSCs) whereas the Statutory Water Companies formed the water only companies (WoCs) (Stone and Webster 2004). Several studies in the past analysed the impact of privatization and regulation on the efficiency and productivity of water companies only in the water industry

[1] Note that cost of production does not consider environmental and resource costs but focused on investment and operational costs.

in England and Wales (Molinos-Senante et al., 2014; Maziotis et al. 2015a; 2015b). Most of the past evidence therefore refers to the WaSCs where WoCs have always been studied together with WaSCs. We note that WaSCs are responsible for water and sewerage services whereas WoCs are in charge of water supply activities only. Only one study evaluated WoC's performance over the period 1995/96 – 2004/5. Hence, in this paper we add to the debate over the impact on regulation on the performance of WoCs by calculating the welfare costs of regulation.

The aim of this study is to analyze the welfare costs of the regulation in the water supply in England and Wales, by computing the deadweight loss of the WoCs providing clean water services that existed over the period of 1993-2009. To achieve this, it is proposed a setting to compute the deadweight loss from non-marginal-cost pricing of marginal water consumption under different assumptions for demand elasticity. Computation of the margins and predictions of the demand of water under different price levels, assuming conservative levels of price-elasticity allow us to report welfare effects estimates from the adoption of the regulation. This methodology is applied on WoCs which are responsible for the supply of drinking water services.

This paper contributes to the current strand of literature on water utilities and welfare economics as follows. First, it shows that contrary to other regulated industries and common wisdoms, water supply in the UK has low-margins, even though these low-margins can have strong welfare impacts. Second, it shows that regulation can have efficiency costs for the market as it implies negative profits for the firm. Therefore, the methodology and results of this study are of great interest for both regulators and water utilities managers to evaluate the effectiveness of regulation and make informed decisions. Undoubtedly, the calculations used in the paper could be refined but the analysis shows that profits and losses are not only transfers between producers and consumers but can have important welfare impacts. Therefore, policy makers should particularly be interested by the potential distortions of the current regulatory tools. This paper is also of interest for researchers as our methodological approach is generally applicable and can be expanded to other regulated industries such as coal, electricity, natural gas or even oil.[2]

2. Methodology

It is proposed a simple setting to compute the deadweight loss from non-marginal-cost pricing of marginal water consumption under different assumptions for demand elasticity. The calculation is based on the standard formula to compute the deadweight loss for each company i on a given year y:

$$DWL_{i,y} = \frac{(|Q_1 - Q_0| * |P - MC|)}{2} \tag{1}$$

where Q_1 is the predicted water consumption at the marginal cost MC and Q_0 is the observed water consumption level at current price P. Q_0, MC and P can directly observed from the dataset[3]. In order to compute Q_1, first it is needed to compute how consumption would change after a change in the price from P to MC. The change in consumption ΔQ can be computed using the simple price-elasticity formula:

$$\Delta \mathrm{Q} = \frac{(\mathrm{MC} - \mathrm{P})}{\mathrm{P}} * \varepsilon * Q_0 \tag{2}$$

where ε is the price-elasticity of demand. Q_1 is then computed as the sum of Q_0 and ΔQ. Note that demand is a linear curve while supply is supposed to be perfectly elastic. This assumption is realistic as in the water industry, infrastructure for transportation and distribution can be scaled up at near constant marginal cost. It is also then easier to compute the marginal cost as it is not needed a cost function for the water companies.

It is helpful to go through an example to understand the aforementioned computations. For instance, in 2000, company C1 has a margin of 11 cents per cubic meter of water consumed and 11.2 million cubic meters consumed this year. The cost of production per unit is 64 cents and the revenue per unit is 75 cents. Using the formula (1), it is possible to compute the expected demand if the price per unit was 64 cents, i.e. if there were no margins. In this

[2] Borenstein and Davis (2012) and Davis and Muehlegger (2011) studied the deadweight loss resulting from non-marginal cost pricing for natural gas in the US. Porcher (2014) applied a similar framework in the French water public service and Davis (2014) discussed the welfare effects of fuel subsidies worldwide.

[3] In this study, information on marginal cost and price was no available in the dataset. Hence, additional steps to compute these variables are needed. They are specified in the sample data section.

case, the increase in demand under the hypothesis of a price elasticity of -0.8 would be 1.3 million cubic meters. Hence, the expected demand at the marginal price would imply consumption to be equal to 12.5 million cubic meters for the year 2000. Using the formula of the deadweight loss, the deadweight loss would be equal to:

$$DWL_{c1,\,2000} = \frac{(12.5-11.2)\times(0.75-0.64)}{2} = 70{,}413 \text{ GBP}.$$

The same computation is repeated every year for each company to compute the deadweight loss under three different levels of price elasticity -0.2, -0.5 and -0.8. The level of elasticities are not taken randomly but are based on a range of price elasticities found in previous studies (see Arbues et al. (2004) and Espey et al. (1997) for a literature review). Very few studies examined the water price elasticity of demand for household use only in England and Wales. For instance, Moran and Dann (2008) assumed a price elasticity of demand for household use of - 0.2 whereas two reported by UKWIR (2003, 2008) suggest a lower value, - 0.14 and - 0.15 during summer and -0.35 during non-summer period, respectively. Therefore, the assumptions regarding the water price elasticity of demand in our study are line with the evidence found in past studies. Rather than taking a strong stand on the magnitude of the credible elasticities, it is reported welfare effects estimates for a relative broad range of elasticities which allows narrowing results uncertainty.

3. Sample Data

Since the privatization of the English and Welsh water industry, there have been several mergers and acquisitions, WaSCs/WoCs and WoCs/WoCs, which resulted in having 21 companies in 2009 – 10 WaSCs and 11 WoCs. Being natural monopolies, the economic regulator, the Water Services Regulation Authority (Ofwat) was set up to regulate industry's performance and review water tariffs. The method of regulation has the form of price cap scheme and is designed to both give firms incentives to increase profits by reducing costs and eliminating the potential to manipulate output prices.

As the primary focus of the paper is to determine the welfare costs of the regulation in the water supply in England and Wales, the analysis focuses on WoCs providing drinking water services that existed over the period of 1993-2009. The sources of data are the *"June Reports for Water and Sewerage Companies in England and Wales"* published by Ofwat at its webpage and companies' annual financial performance reports. The sample is unbalanced as the number of WoCs reduced over the period of study due to mergers with other WoCs or their acquisition by WaSCs.

Selecting inputs and outputs for evaluating regulated companies' performance is a difficult task. It depends on the availability of data, the reliability of the available data and the expertise and experience of the analyst (De Witte and Marques 2010). Following past practice, 3 inputs and 1 output are selected (Saal and Parker 2001; Saal et al. 2011a; Molinos-Senante et al. 2014; Maziotis et al. 2015a; 2015b). Metered water consumption is selected as output and is taken from the companies' regulatory returns to Ofwat. Regarding inputs, the first one is the capital stock which is proxy by Modern Equivalent Asset (MEA) based on current cost estimates of the replacement cost of the water companies´ existing capital stock. Subsequently it is employed a user-cost of capital approach, to calculate capital costs as the sum of the opportunity cost of invested capital and capital depreciation relative to the MEA asset values.

The second input considered is labour expressed as the average number of full-time equivalent (FTE) employees which is available from the companies' statutory accounts. Finally, the third input, namely other costs in nominal terms is defined as the difference between operating costs and total labour costs. Given the absence of data allowing a more refined break down of other costs, it is employed the UK price index for materials and fuel purchased in purification and distribution of water, as the price index for other costs, and simply deflate nominal other costs by this measure to obtain a proxy for real usage of other inputs (Maziotis et al. 2009). Table 1 shows the descriptive statistics for the data sample.

INSERT TABLE 1

Margins are computed as the difference between revenues and total costs and subsequently it is computed the margin per unit, marginal cost and the potential market price. For each year and each company, the marginal cost and the price are then respectively computed as the average costs and average revenues. To do so, it is used the information on operational expenses to compute a per-unit cost of production similar to the marginal cost, under the assumption that there are no scale economies. Similarly, it can be computed the price per unit paid by consumers using the information on revenues. Even if these variables are computed, they provide a good proxy of marginal prices and costs.

Regarding the assumption of no scale economies, Stone and Webster Consultants (2004) estimated a total and variable cost function and found negative scale economies for the WaSCs and constant returns to scale for WoCs at the respective sample means. Moreover, in the price reviews till 2004 Ofwat's approach (Ofwat, 2004) to assess companies' operating and capital expenditure efficiency was the use of cross section econometric techniques and unit cost models where constant returns to scale for WaSCs and WoCs were assumed. Therefore, following past practice (Stone & Webster Consultants, 2004; Ofwat, 2004) we assume that WoCs operate under constant returns to scale.

Figure 1 depicts the evolution of margins over time. The unit of observation is a water company so the box plots show – from top to down - the maximum, third quartile, median, first quartile and minimum margins for each cubic meter sold for each year. For example, in 1993, the average margin is 0.037 GBP/m^3, meaning that on average the difference between the marginal price and the marginal cost of production is 0.037 GBP/m^3. The maximum margin observed is a margin of 0.17 GBP per cubic meter and the minimum is a loss of 0.30 GBP per cubic meter sold. The third quartile is 9.4 cents of GBP per cubic meter of water, meaning that 75% of WoCs have margins lower than this level and the first quartile is a loss of 3.2 cents of GBP per cubic meter consumed. This graph is instructive as it gives the reader a general appreciation of margins in water industries in the UK: margins tend to decrease over time and become negative or close to 0 after 2003. Such negative margins result from the regulation of water prices in the UK based on regular price-reviews giving incentives to decrease costs (Maziotis et al., 2014).

INSERT FIGURE 1

Figure 2 summarizes the descriptive statistics for margins by companies. This graph thus gives information about the spread in the evolution of margins between 1993 and 2009 for each company. For example, over the period, the water company C9 has a median margin of 3 cents of GBP per cubic meter and its margins varies between a loss of 11.3 cents of GBP per cubic meter and a gain of 29 cents of GBP per cubic meter over time. The spread is thus 40 cents of GBP per cubic meter over time while the price of water per unit is on average around 1 GBP per cubic meter consumed. The variation in margins is thus substantially high across time as this graph shows. In most cases, variations in margins are linked to changes in the price set by Ofwat.

INSERT FIGURE 2

Figures 1 and 2 discussed above, illustrate that margins can be positive or negative in the UK water industry, thus imposing deadweight loss as customers might consume too little or too much water.

4. Results

This section describes the results of the setting proposed in the study. It is employed a straightforward exercise by computing the deadweight loss from non-marginal cost pricing of marginal water consumption at different levels of demand elasticity. With non-zero elasticity, volumetric charges above or below the marginal cost impose deadweight loss on the society as customers consume either too much or too little water. It is assumed that consumers do not exit or enter the market and that the deadweight loss observed in the water markets does not cause any distortions in related markets.

A quick overlook at the computed statistics is helpful to understand the amplitude of the deadweight loss. Table 2 reports descriptive statistics per companies such as the margin per unit, observed and predicted consumption under the -0.8 elasticity level and the associated deadweight loss. The larger the amplitude of the margin or the loss, the larger is the gap between the observed and the predicted consumption and the larger is the welfare loss. For example, companies C3 and C12 grossly sell the same volume of water but C3 is close to a nil profit while C12 has pretty high margins of 20 cents per unit sold. Under a -0.8 price elasticity of demand, the average yearly deadweight loss is 46,000 GBP in the case of company C3 while it is 788,000 in the case of C12. Table 2 thus shows that the size of the margin or the loss as well as the level of the price elasticity of demand substantially impact the economic costs of price distortions.

*** INSERT TABLE 2***

Figures 1 to 3 in the appendix report estimates of the deadweight loss, at the water industry level, under different plausible price elasticities, ranging from -0.2 to -0.8. Under a price-elasticity of -0.2, the overall deadweight loss of the industry is 1.135 million GBP in 1993, and it is four times higher with a price-elasticity of -0.8. Table 3 reports the total deadweight loss for the WoCs over the period under different plausible price elasticities of demand, ranging from -0.2 to -0.8. The overall deadweight loss ranges from 15.4 million GBP to 61.5 million GBP under these hypotheses. The magnitude of the deadweight loss varies consequently to the level of elasticity with larger increases in consumer surplus for larger elasticities. Figures 1 to 3 in the appendix show the share of the deadweight loss resulting from positive and negative margins. Negative margins are responsible for the majority of the deadweight loss in 1993, 2001 and from 2003 on: they represent for example 61% of the deadweight loss in 1993 and more the quasi-total majority in 2004, 2005, 2007, 2008 and 2009. These negative margins foster a situation in which consumers experience higher welfare gains than under marginal cost pricing but it results in losses for the firm and to a deadweight loss as it enables transactions for which the willingness-to-pay of consumers is below the opportunity cost. On the contrary, positive margins create a deadweight loss because customers consume too little water. Interestingly, a large part of the deadweight loss is due to positive margins in the 1990s while the inverse situation occurs in the 2000s. These results show that regulation was probably too lax in the 1990s while it was too tight in the 2000s as the water companies barely managed to achieve economic profitability. Over the period, most of the deadweight loss comes from positive margins as the standard literature on monopolies would predict.

Figures 4 to 6 in the appendix present the total deadweight loss over the period (1993-2009) for each company. C10 is the company with the largest deadweight loss over the period, ranging from 3.8 to 15 million GBP depending on the level of the elasticity. The deadweight loss only comes from negative margins. Company C13 is in the opposite situation, provoking a deadweight loss ranging between 1.5 million and 6 million GBP resulting from positive margins over the period. Because margins or losses are pretty low as depicted in Table 2, the overall deadweight loss per company for the whole 1993-2009 period is usually contained between 500,000 GBP and 2 million depending on the level of the price elasticity. However, for companies experiencing high levels of deadweight loss, the price-cap regulation seems to be tight as we would not expect the company to experience such repeated losses.

5. Discussion and policy implications

The setting-up of an independent water regulation authority is often seen as an interesting way to promote more pricing efficiency in regulated industries. However, efficient pricing in the UK water industry could have increased the overall surplus by 15 to 61 million GBP over the period of study. Even if these figures represent a small share of the overall turnover of the industry (0.4% in our dataset, similar to the estimates of Garcia and Reynaud (2003) and Porcher (2014)), this extra-surplus could be used for transfers to the poor or to avoid under-investment on water networks.

From a policy perspective and linking the results with the regulatory cycle, we conclude that during the years 1994-2000, when prices were tightened after the 1994 price review, profits increased. This finding is consistent with previous studies by Saal and Parker (2001), Saal et al. (2007) and Maziotis et al. (2009). The results suggest that even the substantial regulatory tightening after 1994, the period 1994-2000 could be characterised as a period of lax regulation since regulatory revenues almost always exceeded regulatory costs leading to high welfare losses for the customers.

During the years 2000-2005, profits substantially decreased as companies were obliged to reduce the prices charged to customers due to the 1999 price review. Average regulated revenues were always below average regulatory costs indicating that the firms were required to eliminate at least some excess costs in order to regain economic profitability. This study demonstrates that after 2001 the English and Welsh water regulator was more focused on passing productivity benefits to consumers and maintaining stable profitability than it was in earlier regulatory periods. This finding is consistent with past studies by Bottaso and Conti (2003), Erbetta and Cave (2007) and Maziotis et al. (2009) where the authors suggested that the tightened 1999/00 price review had a positive impact on companies' productivity indicating that both the most productive and the less productive firms had strong incentives to improve their productivity in order to regain economic profitability. Another study by Bottasso and Conti (2009) analysed the performance of WoCs only during the period 1995-2005 and concluded that productivity only slightly improved and more particularly after 2000 due to the 1999 price review when Ofwat imposed tougher X factors in the price cap formula, which might have provided strong incentives for water companies to improve efficiency and productivity.

Water companies continued to experience welfare losses during the years 2005-2009 as their profits decreased. Even the 2004 lax regulatory setting after 2004, any gains from increases in output prices were offset by increases in input prices resulting in negative economic profitability (Maziotis et al. 2015a). The findings of this study are reinforced by Portela et al. (2011) and Molinos-Senante et al. (2014) where they studied the impact of regulation on companies' productivity. The authors concluded that the decrease in productivity was larger in the period 2005/08 than in 2001/04. One reason for this deterioration in productivity might be the price cap imposed by the regulator in the 2004 price review. Nevertheless, other factors (such as the rise in electricity prices and the reduction of leakages) might have contributed to higher operating and capital expenditures.

Overall, in several countries, an "incentive regulation" has been implemented to ensure that firms reduce costs and innovate but this regulatory pricing can also lead to distortions on the market. It might be of interest to compare the results of this paper with those of Porcher (2014) which studies efficient pricing for French water companies. In France, prices are not set by a national regulator similar to the UK water industry where the economic regulator, Ofwat, reviews water tariffs, but by municipalities at the local level. Using a dataset of more than 4,000 French municipalities covering half of the French population, the author finds that marginal prices average about 8% more than marginal costs, leading to a small deadweight loss of 8 million euros for 2008 under a -0.2 to -0.3 price-elasticity of demand. Another paper by Garcia and Reynaud (2003) estimates the benefits of efficient water pricing in France and finds small efficiency gains – roughly 0.4% of initial surplus. The results of the paper can also be compared to those obtained in different industries.

6. Conclusion

Evaluating the impact of regulation in privatised industries is of great importance for regulators and companies. This is evident in the water industry in England and Wales where WoCs were privatized in 1989 and since then they have been subject to price cap regulation. In this study, for the first time, it is analysed the welfare costs of the regulation in the water supply in England and Wales, by computing the deadweight loss of the WoCs providing drinking water services that existed over the period of 1993-2009.

The results illustrate that the current regulation can have substantial efficiency costs. Interestingly, a simple look at the descriptive statistics shows that margins are either slightly positive or slightly negative. There are however extreme situations: some companies have constantly negative margins while some others have constantly positive margins. A negative margin means that the company is making losses while a positive margin means that consumers experience losses in their surplus. In both cases, as the market does not clear at the marginal price, there is a deadweight loss and the surplus of the society as a whole could be increased by fixing prices at the marginal cost. Estimates of this study show that the loss of efficiency for the WoCs lies between 15 and 60 million GBP between 1993 and 2009. These amounts could have been redistributed either to the companies in terms of profits or to the consumers via price reductions. Such a result underlines the need to design tariffs properly covering costs and ensuring the right levels of consumption.

From a policy perspective, the methodology and results of this study are of great importance for both regulators and water utilities managers to evaluate the effectiveness of regulation and make informed decisions. Potential distortions of regulatory tools should always be of great interest to policy makers. This paper makes an original contribution to meeting this challenge by computing deadweight loss of water companies to evaluate from a welfare economic perspective of the economic efficiency of regulatory price cap scheme.

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TABLES

Variables	Mean	Standard Dev.	Min	Max
Economic costs (millions GBP)	56.02	59.62	5.45	374.81
Economic revenues (millions GBP)	54.90	49.72	7.95	230.98
Capital Input (millions GBP)	1008.578	934.01	132.88	3872.89
Capital price (GBP)	0.021	0.007	0.009	0.045
FTE employment	310.684	247.164	53	1083
Deflated other expenditure (millions GBP)	14.391	14.061	1.548	74.209
Other costs price deflator	1.733	0.446	1	2.787
Consumption (‘000s cubic meters)	65.5	62.6	8.52	292

Table 1. Descriptive statistics
Source: Own elaboration from OFWAT data

Water company	Margin (GBP/m^3)	Water Consumption (10^3 m^3)	Predicted Water Consumption (10^3 m^3)	Deadweight Loss (GBP)
C1	0.0801203	11,729	12,742	52,110
C2	0.0105611	93,368	94,527	68,244
C3	0.0200266	51,087	52,311	45,997
C4	0.0589885	22,897	24,077	72,933
C5	0.057592	22,513	23,602	187,338
C6	-0.2220574	9,018	7,706	172,458
C7	0.2048994	14,331	16,394	236,732
C8	0.0364477	15,272	15,750	29,956
C9	-0.0055893	50,158	50,029	219,811
C10	-0.1472292	117,615	105,756	1,375,192
C11	-0.2633438	65,004	52,961	1,604,367
C12	0.2120245	52,654	59,063	78,7987
C13	0.1001344	155,751	169,250	748,798
C14	0.0763396	109,514	116,755	337,044
C15	0.0401757	58,192	61,137	155,246
C16	0.0397852	51,921	53,516	144,650
C17	-0.2003357	20,230	17,622	296,543
C18	0.1236774	29,948	32,433	154,255
C19	0.0274029	102,006	105,075	64,949
C20	0.1552026	9,656	10,450	109,383
C21	-0.0202863	277,895	272,524	243,032
C22	0.015067	213,830	217,212	163,498
C23	0.1219347	41,752	46,104	283,072
C24	0.0786834	14,615	15,758	54,590
C25	-0.0717174	172,296	162,857	338,482
Average	**0.0320268**	**65,515**	**66,366**	**245,119**

Table 2. Mean margin per unit, mean consumption, predicted consumption at market price and deadweight loss under a -0.8 price elasticity.

Note: this table presents the mean margin (in GBP), consumption (in thousands of cubic meters), predicted consumption (in thousands of cubic meters) and deadweight loss (in GBP) for each company over the 1993-2009 period under the assumption of a -0.8 price elasticity of demand. For example, under a -0.8 price elasticity of demand, the average deadweight loss of the company C39 over the 1993-2009 period is 338,482 GBP while the average loss per unit made by the company is 7 cents. If the company C39 had price set at the marginal cost, customers would have consume less water, 163 million cubic meters instead of 172 million cubic meters on average per year.

Year	ε = -0.2	ε= -0.5	ε= -0.8
1993	1,134,989	2,837,473	4,539,957
1994	1,423,839	3,559,597	5,695,356
1995	1,558,735	3,896,837	6,234,938
1996	1,700,287	4,250,716	6,801,146
1997	1,722,483	4,306,209	6,889,934
1998	471,738	1,179,347	1,886,956
1999	546,320	1,365,800	2,185,280
2000	1,209,722	3,024,306	4,838,889
2001	394,737	986,843	1,578,950
2002	313,461	783,653	1,253,845
2003	311,471	778,680	1,245,888
2004	766,536	1,916,342	3,066,149
2005	1,163,118	2,907,798	4,652,477
2006	302,854	757,135	1,211,417
2007	974,047	2,435,118	3,896,187
2008	1,185,213	2,963,031	4,740,850
2009	201,683	504,207	806,731
TOTAL	**15,381,237**	**38,453,094**	**61,524,950**

Table 3. Total deadweight loss in GBP under different level of elasticities

Note: this table presents the total deadweight loss in GBP per year under different assumption for the elasticity of demand. For example, in 1993, under a -0.2 price elasticity of demand, the total deadweight loss of water only companies is 1.135 million GBP while it is 2.837 million GBP under a -0.5 price elasticity and 4.540 million under a -0.8 price elasticity. The last line of the each column sums the deadweight loss for the whole period. For example, between 1993 and 2009, under a -0.8 price elasticity of demand, the cumulated deadweight loss of the water only companies is 61.525 million GBP.

APPENDIX

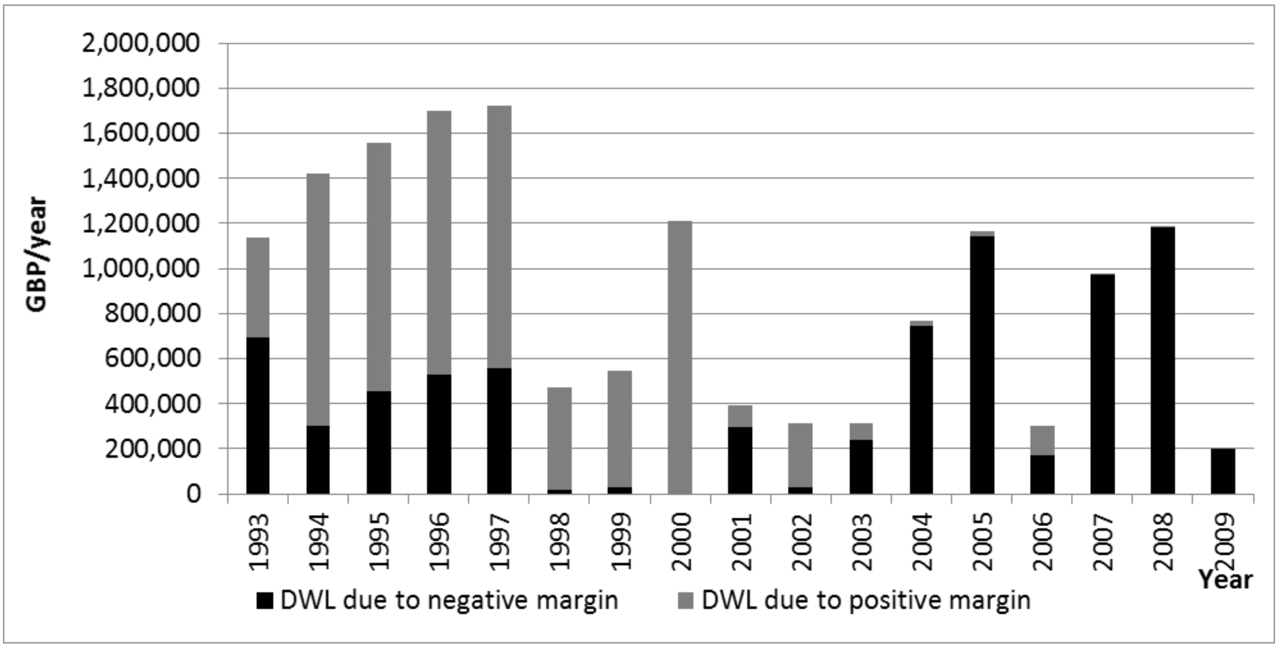

Figure 1. Industry's deadweight loss under a price-elasticity of -0.2

Note: this figure depicts the computed deadweight loss for the sample over the 1993-2009 period under the assumption of a -0.2 price elasticity. The black-coloured area represents the share of the deadweight loss that is due to negative margins, i.e. prices that are set under the marginal cost. The grey-coloured area represents the share of the deadweight loss that results from positive margins, i.e. prices set above the marginal cost.

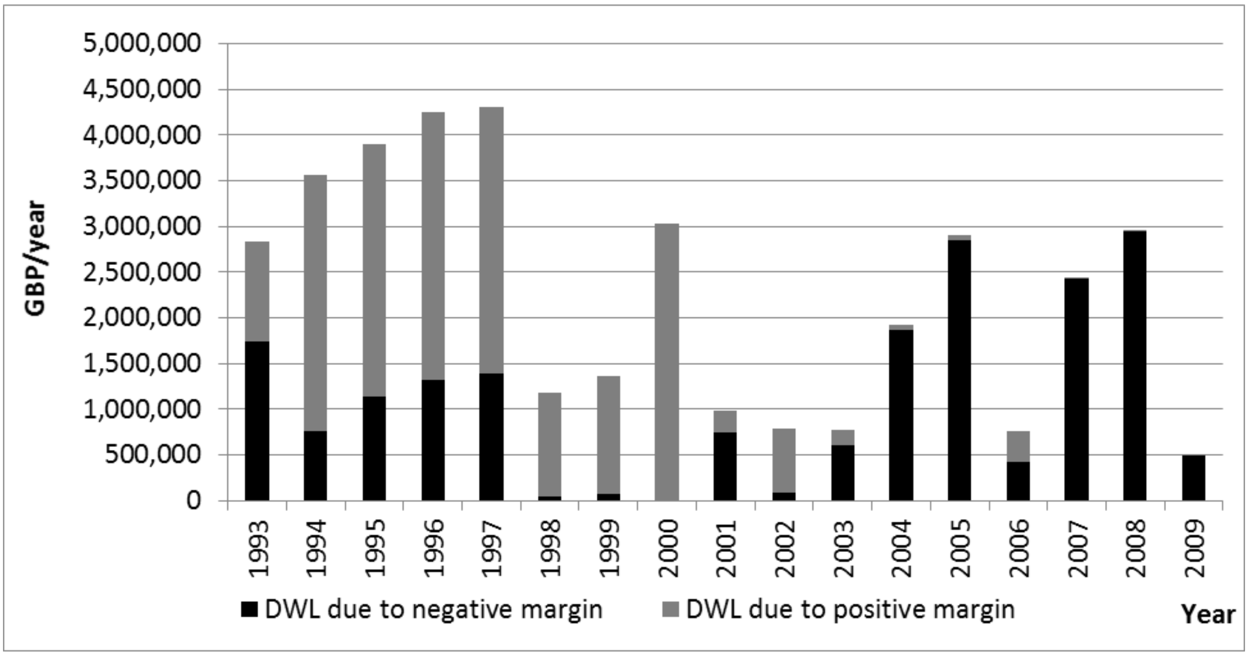

Figure 2. Industry's deadweight loss under a price-elasticity of -0.5

Note: this figure depicts the computed deadweight loss for the sample over the 1993-2009 period under the assumption of a -0.5 price elasticity. The black-coloured area represents the share of the deadweight loss that is due to negative margins, i.e. prices that are set under the marginal cost. The grey-coloured area represents the share of the deadweight loss that results from positive margins, i.e. prices set above the marginal cost.

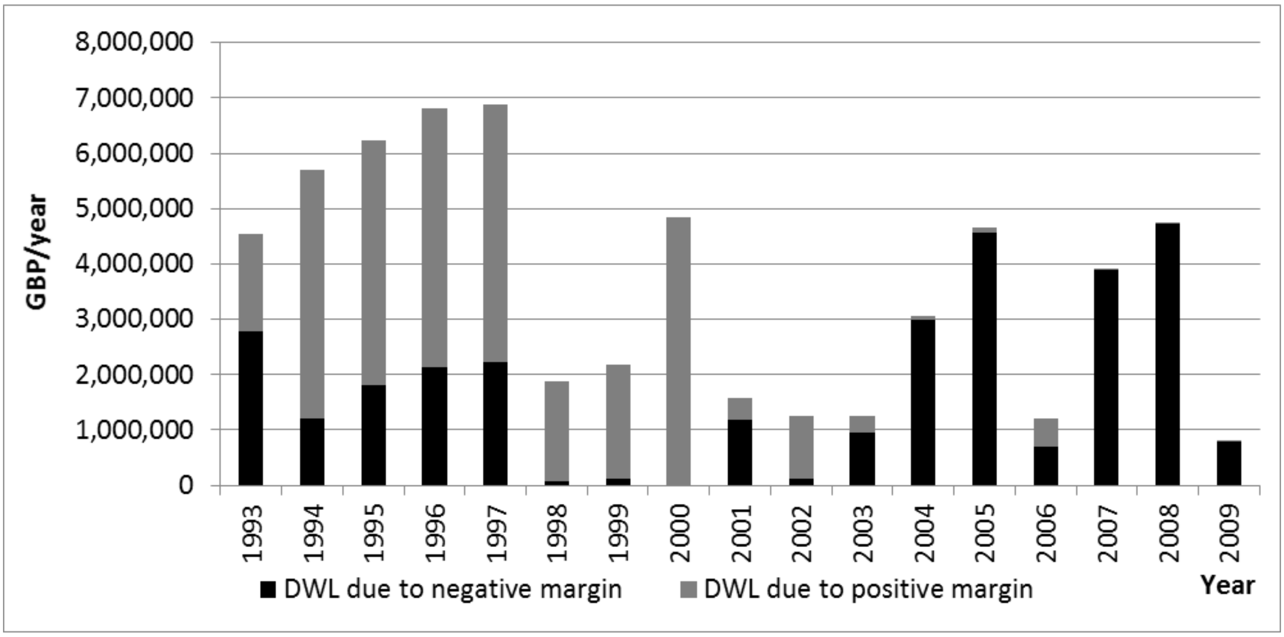

Figure 3. Industry's deadweight loss under a price-elasticity of -0.8

Note: this figure depicts the computed deadweight loss for the sample over the 1993-2009 period under the assumption of a -0.8 price elasticity. The black-coloured area represents the share of the deadweight loss that is due to negative margins, i.e. prices that are set under the marginal cost. The grey-coloured area represents the share of the deadweight loss that results from positive margins, i.e. prices set above the marginal cost.

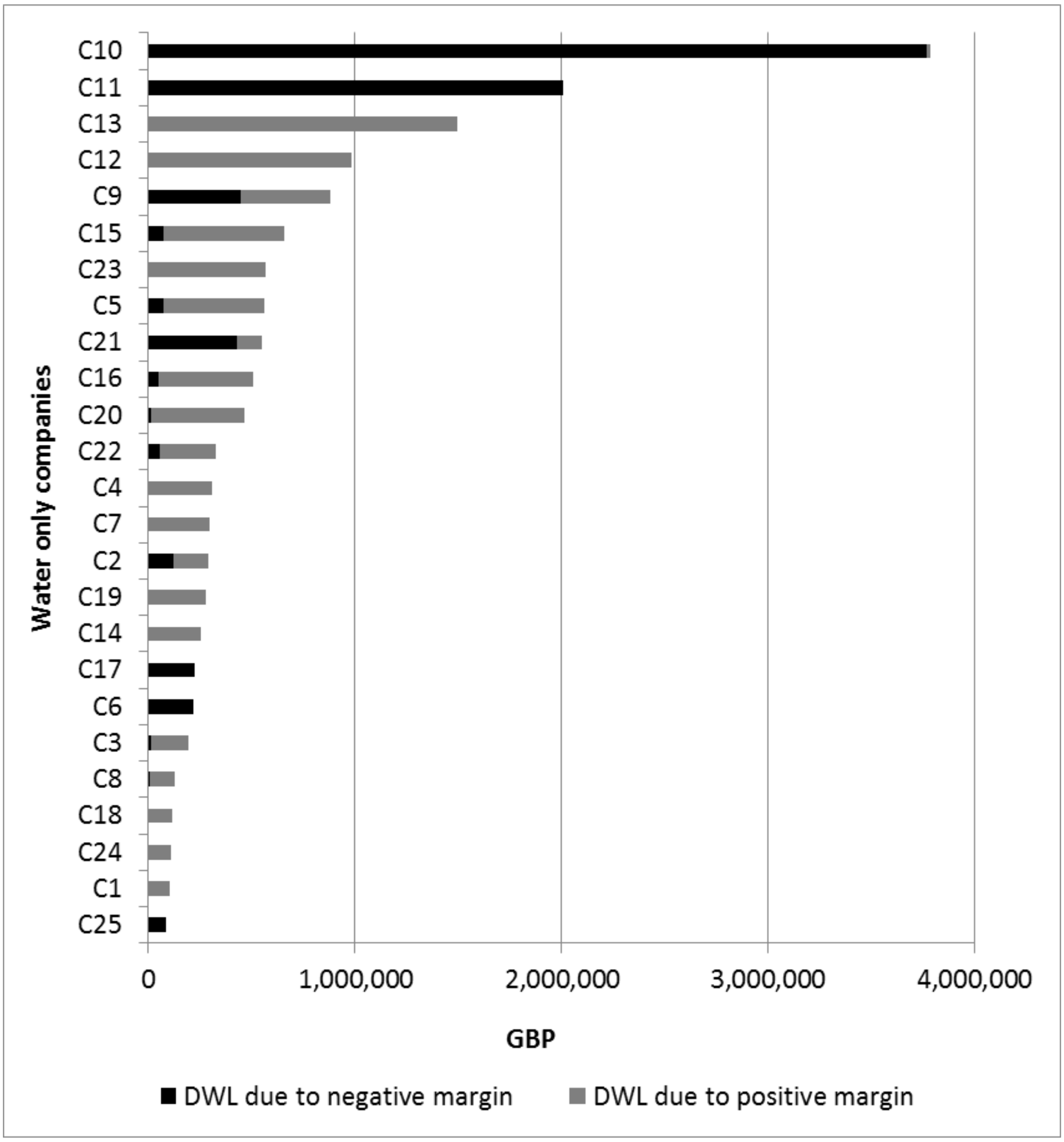

Figure 4. Water company's deadweight loss under a price-elasticity of -0.2 from 1993 to 2009

Note: this figure depicts the computed deadweight loss for each company over the 1993-2009 period under the assumption of a -0.2 price elasticity. The black-coloured area represents the share of the deadweight loss that is due to negative margins, i.e. prices that are set under the marginal cost. The grey-coloured area represents the share of the deadweight loss that results from positive margins, i.e. prices set above the marginal cost.

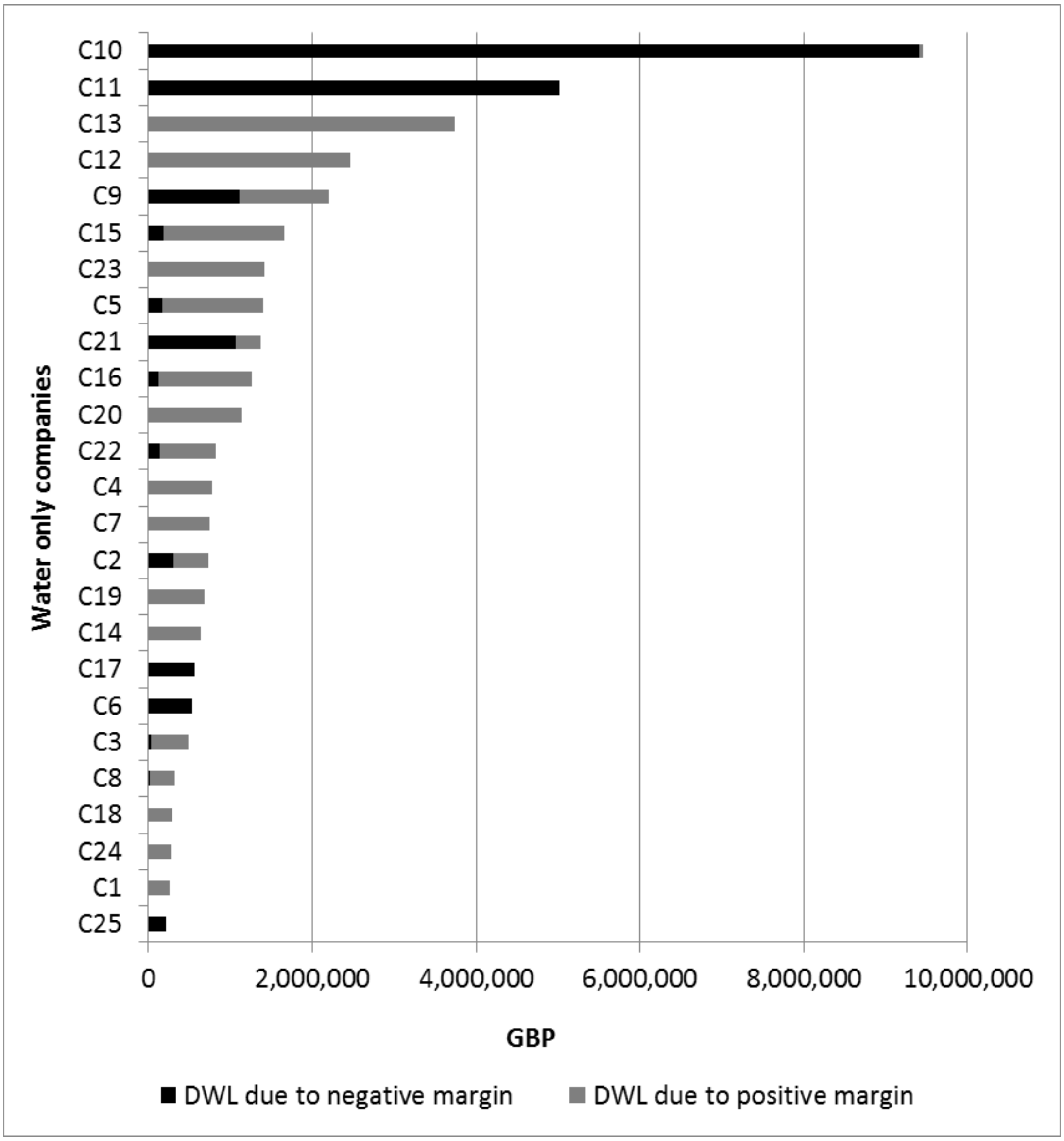

Figure 5. Water company's deadweight loss under a price-elasticity of -0.5 from 1993 to 2009

Note: this figure depicts the computed deadweight loss for each company over the 1993-2009 period under the assumption of a -0.5 price elasticity. The black-coloured area represents the share of the deadweight loss that is due to negative margins, i.e. prices that are set under the marginal cost. The grey-coloured area represents the share of the deadweight loss that results from positive margins, i.e. prices set above the marginal cost.

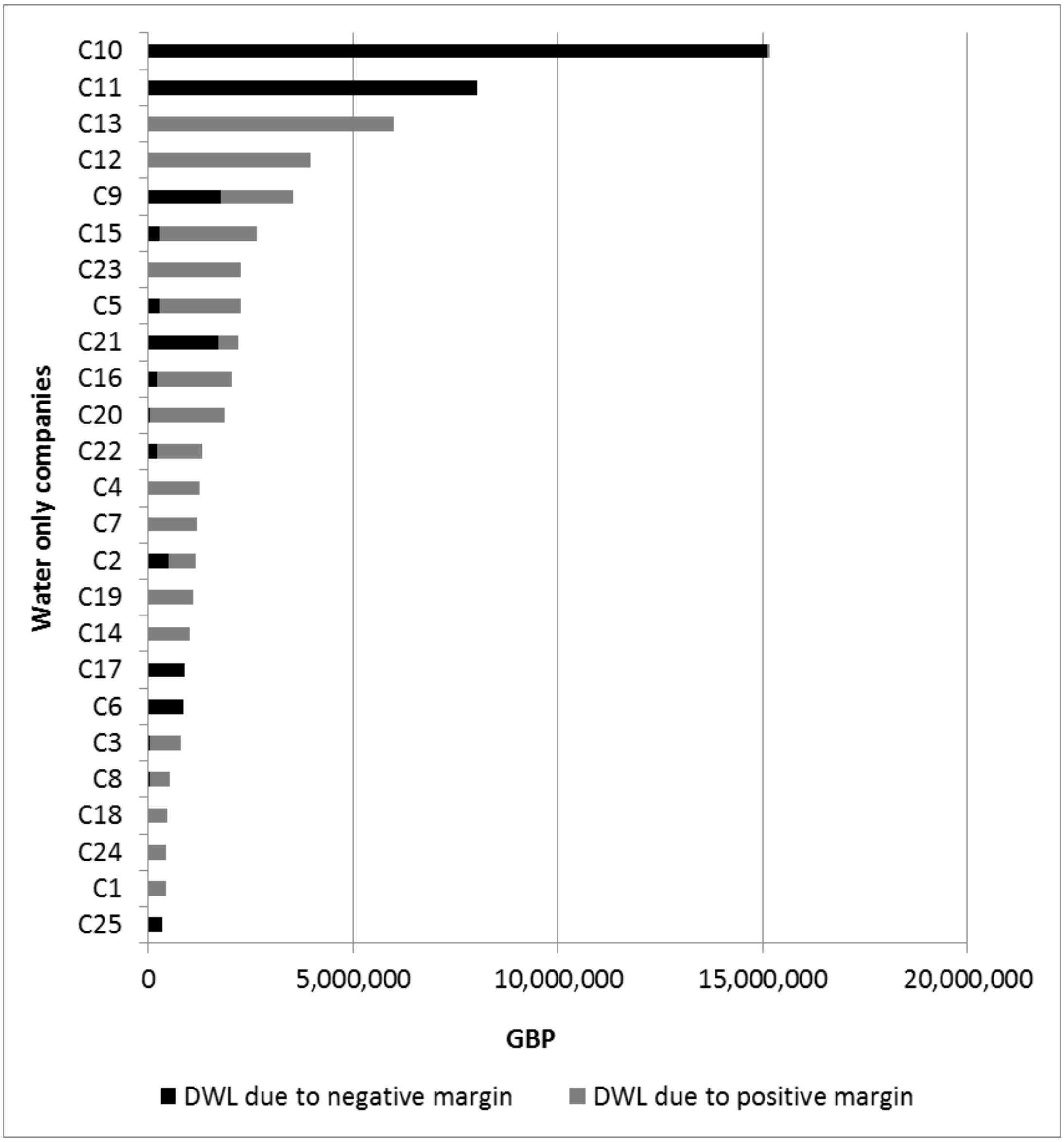

Figure 6. Water company's deadweight loss under a price-elasticity of -0.8 from 1993 to 2009

Note: this figure depicts the computed deadweight loss for each company over the 1993-2009 period under the assumption of a -0.8 price elasticity. The black-coloured area represents the share of the deadweight loss that is due to negative margins, i.e. prices that are set under the marginal cost. The grey-coloured area represents the share of the deadweight loss that results from positive margins, i.e. prices set above the marginal cost.