

PRICE ELASTICITY OF THE RESIDENTIAL WATER DEMAND. CASE-STUDY: INVESTMENT PROJECT IN CLUJ COUNTY, ROMÂNIA

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Abstract

In Romania, local authorities and the newly established Regional Operators, one of them being S.C. Compania de Apă Someș S.A., are required to fully comply with EU regulations concerning water and wastewater quality. In order to meet these requirements in due time, a lot of investment projects have to be prepared and implemented. The financing of these investments requires a progressive increase of the tariffs. In the last ten years, in Romania, the tariffs for the water services have been significantly augmented, more than in any other East European country. In the same time, a substantial reduction of the residential water consumption, measured in liters per capita per day, has been observed.

In this article, the price elasticity of residential water demand for water services was analyzed, given its importance in the framework of the feasibility studies for investments to be made in order to insure compliance with EU water and wastewater Directives. In the same time, considerations with regard to the evolution of the tariff for water services and of the residential water demand are provided, with the aim of better explaining the context in which these variables evolve.

Keywords: residential water consumption, water tariff, price elasticity of demand, sustainable development, Cluj-Napoca.

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1. Introduction

In the context of the global warming, one of the most feared crises is the water crisis. This will occur if water resources will lose their capability to renew due to a severe degradation of the water systems (Bartoszczuk and Nakamori, 2004). In order to avoid such a result, international organizations advocate for a 'sustainable consumption of water', which means, according to OECD (1998 *apud* Bartoszczuk and Nakamori, 2004, p. 2), that water consumption 'should meet basic needs for water servicing without jeopardizing the ability of future generations to meet their water needs and while protecting the water need of the environment'. Still, considering the high decrease in residential water consumption that water operators have to deal with, the fear is lately related to the fact that a too low consumption can alter the quality of water because the system's optimum functioning was designed for different parameters. Moreover, the National Administration of Romanian Waters gave no signs of concern regarding a lack of water resources that could affect the drinking water system. Under these circumstances, water operators do not need to make significant efforts towards water conservation. Even so, the optic of sustainable development and of environmental impact can still be seen in the efforts of modernizing or building wastewater treatment plants, also requested by the EU Directive on wastewater treatment.

On the other side, the United Nations' General Assembly explicitly 'recognizes the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights' through Resolution no. 64/292 from August 3, 2010 (UN, 2010). In Romania, the Sectoral Operational Programme for Environment (SOP – Environment) aims to improve the quality and the access to water and wastewater infrastructure, by providing water supply and wastewater services in line with EU practices and policies at accessible tariffs and by creating innovative and efficient water management structures. According to these objectives, Romania has committed itself to ensure compliance with the requirements of the Drinking Water Directive, in accordance with some intermediate targets. The SOP – Environment promoted the increase of the number of population connected to basic water services in a regional system according to the targets presented in Figure 1.

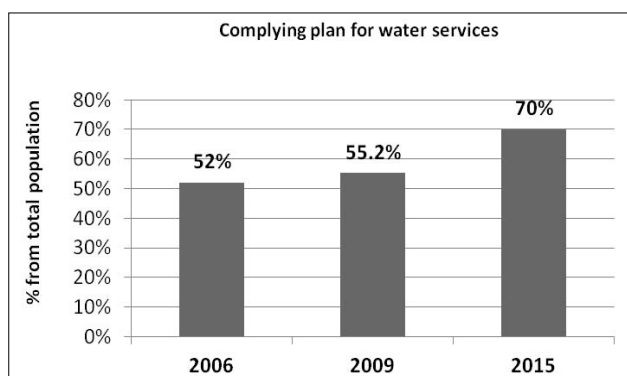


Figure 1: Targets for increasing the number of population connected to water supply services

Source: SOP – Environment, 2007

Concerning sewerage services, Romania will ensure a gradual increase of collecting systems and wastewater treatment in accordance with the following minimum overall population equivalent rates, according to the timeframe presented in Figure 2.

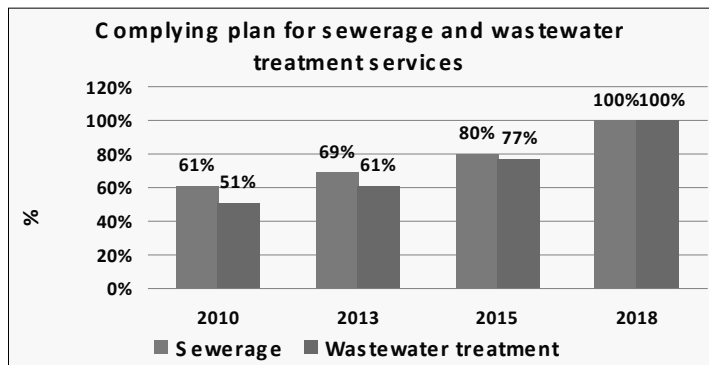


Figure 2: Complying plan for sewerage and wastewater treatment services (population equivalent rates)
Source: SOP – Environment, 2007

Today, Romania has a lower access to water services than any other Eastern European country, as it is reflected in the most recent available data on Eurostat, from 2009, and as it can be seen in Figure 3.

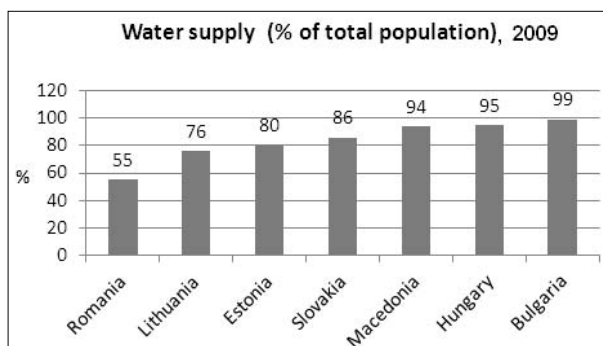


Figure 3: Access to water supply services, as share from the total population of the country, 2009
Source: Eurostat, 2009

Because of the large infrastructure costs, water supply and sewerage services are considered to be natural monopolies (Nauges and Van den Berg, 2007, *apud* Bisztray, 2010) since no potential competitor would invest in infrastructure because the costs could never be refunded from the benefits. Under these circumstances, the tariffs set up by the water supply and sewerage services’ operators are under strict regulation of the National Regulatory Authority of Public Services (ANRSC in Romanian) and have to be approved by the local authorities.

Over the last ten years, the Romanian water supply and sewerage sector benefited from major investments projects, such as: MUDP (Municipal Utility Development Programme), ISPA (Pre-Accession Instrument for Structural Policies), SAMTID (Small

and Medium Towns Infrastructure Development Programme), PDR (Rural Development Programme), POS Mediu (Sectorial Operational Programme for Environment). The result of these investment programs' implementation is an improved state of the water supply and sewerage infrastructure, achieved through modernization or rehabilitation of the old one and extended access to the water supply and sewerage to new consumers, achieved through the network's extension works. Even if the large percentage of the investments funds made under these programs came from EU and Government sources, a smaller part had to be covered by water operators and came from loans, mostly guaranteed by the municipalities. Living under the pressure of the loan reimbursement, the water operators have to periodically redesign their tariffs in order to cover both inflated operational costs and debt service. One of the consequences of the tariff's augmentation (or so it seems) is the reduction of the amount of water consumed per capita.

In their tariffs' design process, water supply and sewerage operators take into account the operational costs, the debt servicing, the number of customers served and the inflation. One thing they do not consider is the price elasticity of demand, if there is any. As foreseen in the economic literature, the price elasticity of demand represents the percentage change in the quantity demanded of a good or service divided by the percentage change in its price, other factors remaining unchanged.

$$E_d = \frac{\Delta Q\%}{\Delta p\%} = \frac{\frac{\Delta Q}{Q_0}}{\frac{\Delta p}{p_0}} = \frac{\Delta Q}{\Delta p} \cdot \frac{p_0}{Q_0}$$

where: E_d – price elasticity of demand; Q – quantity demanded; p – price.

If $E_d < |1|$, it means that the relative change in the quantity demanded ($\Delta Q/Q$) is smaller than the relative change in the price ($\Delta p/p$) or the demand is inelastic with regard to price. If $E_d > |1|$, it means that the percentage change in the quantity demanded is larger than the percentage change in price or the demand is elastic with regard to price.

2. Considerations with regard to the water and sewerage services' tariff

One of the indicators taken into consideration by the literature and even in the forecast of tariffs' augmentation, considered in the investment project's financing plans, designed by water operators, is the tariff's affordability. This indicator represents the share of a household's income spent for the water bill, and according to the literature, it should not overcome 4% in order for the level of the tariff to be considered socially sustainable. An image of the share of the water bill in the household's income is provided by the 2010 European Benchmarking Co-operation Report, which took in consideration data from 45 water suppliers, coming from 25 European countries, including Romania. 'Most utilities' water bills (including Value Added Taxes) span around 0.5% of the disposable household income. The scores show a substantial spread from 0.2% to 1%.' (European Benchmarking Co-operation, 2010, p. 15).

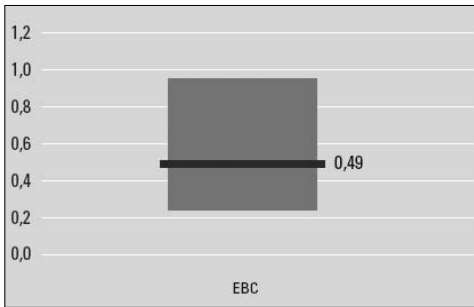


Figure 4: Share of water bill in the disposable household income (%)
 Source: European Benchmarking Co-operation, 2010, p. 15.

In Romania, the water and sewerage tariffs are calculated based on the production and operating costs, maintenance and repairs costs, costs deriving from concession contract, and contain a development component and a profit component. The tariff structure should be prepared according to the Framework Regulation on organization and management of water and sewerage public services. The tariff should be endorsed by the National Regulator and approved by the local authorities.

That is why tariffs are very dispersed among suppliers, for example in 2009, the tariffs for the water services were the equivalent of between €0.64 and €1.14 and, in 2010, of between €0.68 and €1.24. Another issue with consideration to water and sewerage tariffs is the billing method, based on a metered or on an unmetered consumption. We can observe, in the data provided by the National Statistics Institute, that the metering level increased very much in Romania and it is now at a level that we could call a 'good' level of 86.7% of the water sold in 2010.

Even if the tariff's affordability is an important indicator for the tariff's level, the water and sewerage services' suppliers still have to tailor the tariff's levels in order to cover their costs. Mostly because of inflation and debt payment for investment loans, water and sewerage suppliers consider tariffs' increase when needed.

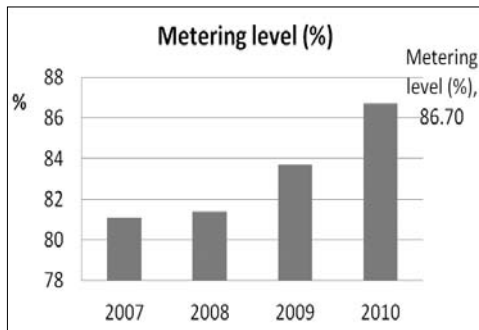


Figure 5: Metering level in Romania (%)
 Source: National Statistics Institute

Even if the tariff's affordability is an important indicator for the tariff's level, the water and sewerage services' suppliers still have to tailor the tariff's levels in order to cover their costs. Mostly because of inflation and debt payment for investment loans, water and sewerage suppliers consider tariffs' increase when needed.

The water utility in the Cluj-Napoca municipality is S.C. Compania de Apă Someș S.A. and it was established in 2005, by the reorganization of the Regia Autonomă Județeană Apă - Canal Cluj, by Decision of the County Council. S.C. Compania de Apă Someș S.A. is a regional operator, supplying drinking water and sewerage in municipalities, towns and in rural areas from two counties. The Company's activity takes place according to the Public Services Law regarding the organization and the functioning of the public services of water supply and sewerage with publicly owned capital, with the following goals: i) to ensure the efficient operation and maintenance of the water supply and sewage systems, and ii) to ensure provision of the water supply and sewage services in a diligent and professional manner.

Tariffs for water and wastewater services are based on cost recovering principles. Starting with 2008, a unified tariff was implemented in the whole supply area of the

Regional Operating Company (ROC), in accordance with the covenant set up in the Delegated management contract.

3. Considerations with regard to the residential water consumption

We cannot investigate the relationship between price and consumption without taking a closer look to the trends in consumption. Using data provided by the Romanian Water Association, we conclude that there is a descending trend in water consumption from 1990 up to the present. Also, data provided by the National Statistics Institute reflect the same trend, in the last years, for which we have found relevant data.

If we take a look at the water consumption (in liters per capita per day) in other European countries, we can state that the water consumption in Romania is not an outlier and the decreasing trend in the quantity of water consumed is rather a 'normal trend'.

4. Methodology

Using the data provided by the water and sewerage services' supplier C.A. Someș S.A., we calculated the average tariff for drinking water, sewerage and rainwater per year, in the period 2002-2010. An average tariff was calculated for each year because the tariff level was not always constant throughout the year. We calculated an aggregated tariff taking into account the share of wastewater and rainwater billed in average for every cubic meter of drinking water and the tariffs for these services. We consider that we have to take into consideration all the water, wastewater and rain water tariffs when calculating the impact of price on the consumer's demand because, though the consumer controls only the quantity of the drinking water consumed, the perceived cost would supposedly take into consideration the tariffs for the wastewater and rain water billed also.

To the aggregated tariffs calculated on the data provided by the water supplier, we added the Value Added Tax. In 2010, the VAT changed from 19% to 24% starting with the first of July, so we considered this issue when we calculated the aggregated tariff for 2010. After that, we calculated the real term aggregated tariffs, using the Consumption Price Index provided by the National Statistics Institute.

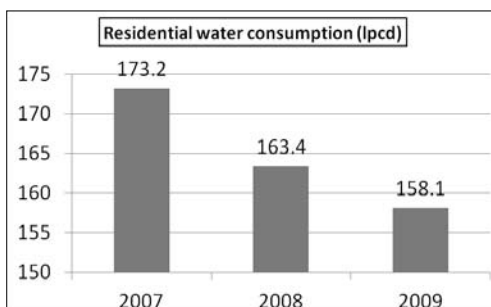


Figure 6: Residential water consumption from the centralized water system, at country level (liters per capita per day)

Source: National Statistics Institute

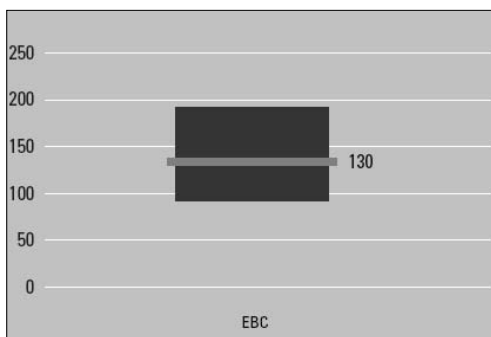


Figure 7: Residential consumption (liters per capita per day)

Source: European Benchmarking Co-operation (2010, p. 31)

This aggregated tariff per year, including VAT, is represented in Figure 8 below and we can observe an augmentation trend from 2002 to 2010, the level in 2010 being more than two times higher than the one in 2002.

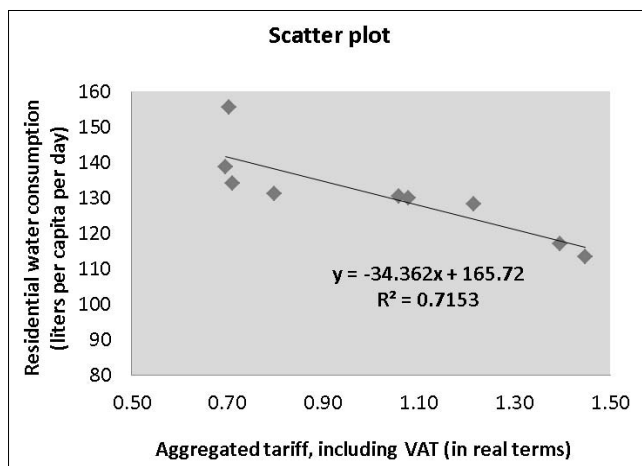


Figure 8: Aggregated average tariff per year, including VAT, in real terms, at Cluj-Napoca municipality level
Source: Authors' calculations

Another set of data that we used was the total amount of water billed per year at the level of Cluj-Napoca municipality, for the period 2002-2010 and the population served with water, in the same area. Using this data, we were able to calculate the average water consumption, in liters per capita per day (lcpd), which is presented in Figure 9. We can observe a decreasing trend in residential water consumption, measured in liters per capita per day, for the considered period of time.

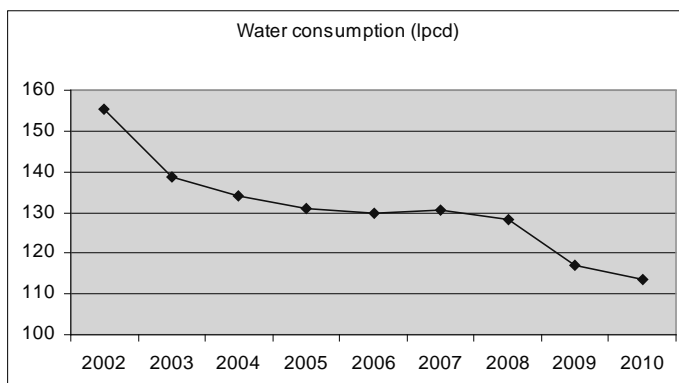


Figure 9: Water consumption per person per day, at Cluj-Napoca municipality level
Source: Authors' calculations

We used statistical tests in order to assess the relationship between the tariff level and the quantity of water consumed and we calculated the price elasticity of water demand.

5. Results

The Pearson correlation coefficient between the tariffs' levels and the quantity of water consumed per person per day is of -0.84, which means that, between the 'perceived', aggregated tariff and the quantity of water consumed, there is a strong negative correlation, fact that can also be observed from the graphic display of the two data sets. In the scatter plot for the two data sets, presented in the Figure 10, we observe that a linear regression line fits the model well.

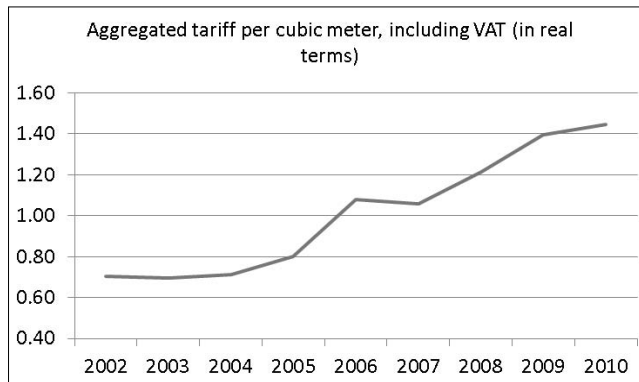


Figure 10: Linear regression for water consumption

For the parameters' estimation, the method of least squares was applied. After estimating the model's parameters, through this method, the results presented in Table 1 have been obtained.

Table 1: Characteristics of the regression model

	Coefficients	Standard Error	t Stat
Intercept	165.72	8.60	19.26
Aggregated tariff	-34.36	8.19	-4.19
R ²	0.71		
F	17.58		
Significance F	0.004		

Using the regression function, we calculated the quantity of water consumed for an aggregated tariff in real terms of 2 Lei (the Romanian currency) per cubic meter and respectively, for an aggregated tariff in real terms of 2.01 Lei per cubic meter. Replacing these data in the price elasticity of water demand formula, we obtained a price elasticity of residential demand of -0.70.

This value of the price elasticity of demand for water is situated within the typical range for water price elasticity of demand, of between -0.2 and -0.8, found in studies carried out by the World Bank (Lovei, 1992, *apud* Asian Development Bank, 1999, pp. 44-45).

6. Conclusions

The price elasticity of water demand at the level of Cluj-Napoca municipality is of -0.70, which means a rather inelastic demand; using data for the Cluj-Napoca municipality for nine years, we calculated the price elasticity of demand for the water supply services and we can conclude that there is a reaction of the demand's decrease with the increase of the tariff, but the effect of the tariff on the water demand is low, mainly because the demand for water is influenced, also, by other factors than price, such as:

- the tariff's affordability – though increasing in real terms, the water bill represents a low share from a household's income or, we could say that the comparative price is low meaning that people could purchase a low quantity from other goods instead of the water consumed;
- water is a product serving basic needs, so the residential demand cannot decrease under a certain amount;
- the services' quality – we can consider that the tariff represents the counter value not only of the water consumed but, also, of the associated commercial services offered by the company. The consumers may accept the increase of price for a higher quality of the services (since water is considered to be of a good quality, as in the case of Cluj-Napoca municipality), but not over that level.
- the metering level – it seems that metering has an effect on the consumer's awareness of the water quantity consumed.

We can conclude that a periodical tariffs' increase, in accordance with the different financing schemes, agreed by the regional water operator with different donors, determined a reduction of the average residential consumption. Also, the occurrence of the financial crisis introduced disruptive factors in the relationship between the water tariffs and the consumed quantity.

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