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## Factors and trends of economic efficiency in the water/wastewater sector

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### Abstract

In this paper we aim to analyse some of the main factors that can influence the economic efficiency of the water/wastewater sector, such as:

- the process of regionalization;
- the principles and features of the pricing policies;
- the price elasticity of water demand.

We shall also highlight some specific trends, issues and challenges for a sustainable development of the water/wastewater sector in Romania, concluding with recommendations.

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*Keywords:* water/wastewater sector; regionalization; water pricing; economic efficiency; sustainable development

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### 1. Introduction

The proper management of water resources is an essential component of growth, social and economic development, poverty reduction, equity, and sustainable environmental services— all important for achieving the Millennium Development Goals.

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Sustainable development depends on managing the costs of service provision using existing infrastructure along with additional investments in new water infrastructure and rehabilitation, both physical and institutional. Therefore, in the last decade, the water/wastewater sector is undergoing important institutional, economic and technological reforms, aiming at ensuring the financial as well as environmental sustainability of the water and wastewater utilities and services.

## 2. The regionalization of water/wastewater utilities

In the European Union member countries, the contemporary policy on water resources use embodies some trends that can also be characterized as its main objectives, animated to a great extent by the European Water Framework Directive 2000/60/EC. These trends, as identified by Bithas, 2008 are:

- Sustainable use of water resources;
- Shift from water supply management towards demand management;
- Privatization of water companies and creation of a competitive market in the water supply industry;
- Defining efficient prices that reflect the actual costs of water use;
- Reduction of the operational and investment costs in the water industry.
- We would like to propose here and analyze another trend:
- Regionalization/aggregation of the water/wastewater utilities.

However, as stated by the above cited author Bithas, 2008, it appears that the sustainable use of water resources and the reduction of costs in water supply industry comprise the primary objectives of the water policy; the remaining trends formulate the instruments to achieve the basic objectives.

Indeed, the regionalization of the water and/or wastewater utility companies may be an instrument to improve the use of water resources and to reduce the operational and investment costs in the water/wastewater sector, by achieving economies of scale. Water systems reforms such as aggregation and regionalization are usually considered when there are perceived inefficiencies in the management of water supply and sanitation WSS services.

A regional public water supply and wastewater utility represents the entire technological, operational and managerial system resulted from the combination of two or more local drinking water supply and wastewater systems. The main objective in creating a regional drinking water and wastewater system operator is to optimize the performance of the operations and quality of supplied services, by using joint resources and facilities.

The main factors driving the consideration of aggregation regionalization and thus increasing the water utility's size include Frone Simona, 2008:

- Increased economic efficiency through economies of scale
- Access to water resources and integrated water resources management
- Broader former decentralization processes
- Enhanced professional capacity in larger scale of operation
- Access to finance or/and to private sector participation.
- Cost sharing between higher- and lower-cost service areas

Our conclusion in Frone Simona, 2008 was that although there are some important benefits of the regionalization and aggregation of water and wastewater services which may act as driving factors of the process, each of these driving factors may also face some specific constraints or perceived disadvantages. Nevertheless, to highlight economic efficiency issues, we should resume some outcomes and conclusions on the economies of scale to be achieved through regionalization and integration of water/wastewater utilities.

A basic economic analysis of the water/wastewater sector would show that water and sanitation services involve large shared infrastructure costs, and adding more customers usually means that each one pays a

smaller share of these costs, i.e. scale economies are being achieved. However, as the systems become larger, growth in the administrative and coordination costs of running them can start to outweigh gains in the unit costs of service provision - the so-called X-inefficiency.

The total water cost function may be expressed as a quantitative relationship aiming to describe the cost of supplying output at each scale, from zero up to the system's theoretical capacity, in any time-period. For the economic analysis, a total water cost function can be approximated by a quadratic function of the form (1):

$$TC(Q) = aQ^2 + bQ + c \quad (1)$$

where TC are total costs, Q is the quantity of water and a, b, c are the parameters of the relationship, estimated through regression analysis.

The average costs of water  $AC = TC/Q$ , are equal to the total costs divided by the unit of water produced. Still more important for economics may be the marginal costs, since they express the incremental costs of getting one more unit of water and determine the right incentives to proper, sustainable management of water. The marginal cost of water supply  $MC(Q) = \Delta TC/\Delta Q$  is strictly positive and tends to be increasing in the short term, due to scarcity and capacity constraints Billi and all, 2005.

Another very relevant issue for the water supply is the specific economies of scale, measured by the output elasticity of total costs. The water output elasticity of total costs  $E_{TC,Q}$  is defined as the percentage change in total costs per unit percent change in quantity supplied. Depending on whether there are economies or respectively, diseconomies of scale, the output elasticity of total costs  $E_{TC,Q}$  can be lower or higher to unity; it may also be equal to unity, if the costs are constant all along the relevant values.

A most interesting and important international study of economies of density scale and scope in the water supply and sewerage sector of four developing and transition economies Nauges Celine and van den Berg Caroline, 2008 confirmed our statements in Frone Simona, 2008 by empirically showing increasing returns to scale in Romania 1.05, Moldova 1.21 and Vietnam 1.16, where the water and sewerage industry is found to be characterized by economies of scale.

The study also found significant economies of customer density in Romania, Moldova and Vietnam; an increase in the total volume of water produced along with an increase in the number of water connections while holding the network length constant was found to decrease average variable cost of water/wastewater utilities in Romania. Water/wastewater utilities in Romania exhibited increasing returns to production and customer density, with returns of around 1.2 in most cases. Another important trend is that the estimated returns to scale decrease with utility size, as measured by the total volume of water produced or the number of water connections served.

The involved economies of scale are very needed, but the overall objective of water utilities' aggregation in Romania is to improve the standards of municipal water and wastewater services by creating efficient, financially viable and autonomous integrated regional service providers able to plan and implement investments in the context of a consolidation in the sector, in line with EU policies and practices. Thereform and development of the water sector is governed by the Sectorial Operational Programme Environment SOP ENV, with the overall objective to protect and improve the environment and living standards in Romania, focusing in particular on meeting the environmental acquis.

- **Principles and features of the water pricing policies**

Although the process of regionalization of water/wastewater utilities is almost completed in Romania with 42 current Regional Operating Companies, developing efficient, financially viable and autonomous integrated regional service providers able to plan and implement investments in the context of a process of consolidation in the sector, in line with EU policies and practices -may face some additional challenges, especially in times of economic and financial recession.

For a sustainable development of the water sector, our national and European water policies need a mechanism to allocate water where it is most needed, and a financing mechanism to generate revenues and leverage additional sources of finance.

Public water supply and sewerage services represent one particular area of water policy that has become increasingly subject to pricing principles. Here too, efficient and effective water pricing systems should provide incentives for efficient water use and for water quality protection. They also should generate funds for necessary infrastructure development and expansion, and provide a good basis for ensuring that water services can be provided to all citizens at an affordable price.

Although the legal framework for a sustainable water management is in force and comprehensive, there are still some challenges in implementing sustainable water pricing in Romania, as we shall try to point out below. The Romanian Water Law no. 107/1996 as further amended and completed stipulates in Art. 80 (1) on the Water Economic Mechanism that it shall apply the cost recovery of water services, including the environmental costs and resources involved, based on economic analysis and on the polluter pays principle.

A comprehensive study of the water sector Platon and Dulcu, 2004 had identified some of the main policy issues for the water sector development in Romania, at that time: residential water demand was still at a high level, due to water losses in the obsolete distribution networks and water wastage by the consumers; new sector investments should take into account the likely drop in water consumption brought about by an improvement of the water supply network, metering and pricing system.

We shall see that, in the meanwhile, the important improvement in the water metering penetration and the doubling of the water supply and sanitation price have indeed produced a drop in the water consumption in Romania, still without affecting the financial sustainability of the water/wastewater utilities.

There are four principles of sustainable water management which should be taken into account when developing a sustainable water pricing structure, as proposed and analyzed in Frone Simona, 2012: full cost recovery; equity; economic efficiency; administrative feasibility and viability. The challenge is to implement a water pricing policy with a good balance of these principles, which may be conflicting.

For instance, the metering of water consumption is a prerequisite for the application of efficient water pricing policies, and a tool for water demand management saving long-run costs in terms of reduced impacts on the resource. But, from the viewpoint of the administrative feasibility and viability principle, metering generates costs and may also reduce revenues for the water company, causing net cash flow problems.

Benefits from metering will therefore depend in part on the price elasticity of demand Dalhuisen, J., et al., 2003. However, at present, metering penetration is currently high enough in many EU countries, as reported by a recent survey OECD, 2010: 95% in Sweden, and about 100% in Belgium, France, Portugal and Hungary, 96% in the Czech Republic, Poland and Romania usually at the level of buildings.

Due to the metering and taking into account the important rise in the price of WSS services meanwhile (of over 100%), the total water consumption (l/person/day) has decreased dramatically (by more than 25%) in Romania (from 206 l/person/day in 2006 to only 153 l/person/day in 2010); for comparison, in the same period, total water consumption has decreased by only 5% in Poland, and by 10.3% in the Czech Republic (the margin of water saving was lower than in Romania).

Indeed, prices for WSS services in Romania increased by almost 104%, from December 2005-December 2010, according to the National Statistics Institute (Romanian Statistical Yearbook 2011). Thus, the growth of

tariffs for water and sewer was three times higher than the general price index, inflation accumulated over the last five years being 34.33%. This leads to the question whether these tariffs increases were justified by the necessary investment needs and financial viability of the water operators or this is an effect of their natural monopolistic position?

Of course, the financial sustainability of operators is another requisite for the sustainable operation and development of water services. The key issues of sustainability are the level of revenues and their stability or predictability. Data from IBNET and other surveys show that, for domestic services, providers in most countries, on average cover at least operation and maintenance (O&M) costs, sometimes with large margins as in Denmark and the Netherlands (Frone Simona, 2012).

Since other financing instruments (taxes and transfers) are more volatile and beyond the reach of the water community, cost recovery through tariffs is a significant driver of the financial sustainability of water/wastewater operators (utilities).

### • Prospects and issues of sustainable development in the Romanian water/wastewater sector

In the case of Romania, large investments in consolidating and expanding water and sewer services were and are still required, as was the increase in efficiency of the water operators, (including utility service concessions to private companies, as in Bucharest). On the other hand, the lack of competition and the fact that prices of services, and their increase, were dictated solely by administrative measures (not by the fair relationship between market supply and demand), have contributed greatly to the doubling of water and sewerage prices. Romanian National Institute of Statistics data (INSE, 2011) shows that the rise of water and sewerage services in the last five years far exceeded the increase in production costs for water operators. Thus, if the water consumer price became more expensive (by over 100%), producer prices in this sector increased between 2005 and 2010, with only 55%. Apparently, as concerns the WSS pricing policy in Romania, the principle of efficiency enters in conflict with the principle of equity, since in the last years, marked by the global economic and financial recession, the burden of increase in the price of water, required by the cost recovery policy stipulated by the EU Water Framework Directive and the Romanian Water Law, was mainly supported by the impoverished Romanian people (those 56% lucky enough to have access to public water supply, in 2010). This trend clearly states the importance of the price elasticity of water demand in Romania, for the water sector development policies and prospects. Our computations based on water demand modeling in Romania, for a longer time period (1998-2009) have resulted an estimated parameter of -0.385 for the price elasticity of water demand Frone Simona, Frone D.F., 2012.

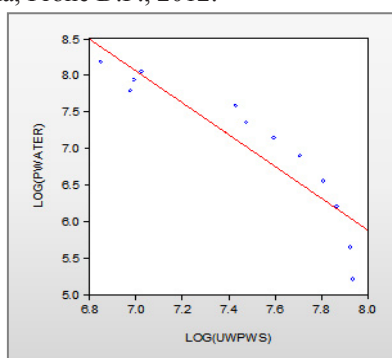


Fig.1. Water consumption from the public water supply (UWPWS) decreasing with the water price (PWATER) increase in Romania

As a first conclusion, based on the empirical evidence above, we may state that in Romania, water pricing was and will continue to be a strong economic instrument for water demand management. Due to the vital water benefits and services for people and communities, we consider that the estimated water demand function (Fig. 1) is quite steep in Romania; respectively the price elasticity of demand for water and the willingness of consumers to give up water use, in the face of rising prices, are quite high.

This trend may somehow jeopardize sustainable development prospects of water supply and sanitation (WSS) services in Romania. Since water is a quasi-public good, and currently in Romania only about 50% of the population has access to public water supply, sewerage and sanitation, (due to the underdevelopment of water/wastewater infrastructure), the economic efficient pricing of water should not prevent Romanian people and businesses from connecting to public water utilities and consuming the right amount of water needed for a modern and civilized lifestyle and/or technological purposes. Instead, water pricing should reduce and prevent the waste or loss of publicly supplied water, by ensuring also the continuity, further development and maintenance of the water and wastewater services and utilities.

Implementing an efficient and really sustainable water pricing system by the water management authorities and companies, with all the involved principles and features, may be a difficult task. Some practical strategic steps for this may require: long-term planning of financial management, investment, development, and pricing at water companies; economic optimizing of the activity taking advantage of economies of scale of water utilities; proper economic assessment of the costs of water and WSS provision; acknowledgement of the cost-price-demand correlation (function); addressing equity concerns of policy choices.

Further theoretical and empirical research will be dedicated to the analysis and comparison of the effectiveness of different policies and models for a sustainable development of the water/wastewater sector in Romania and other European Union member countries.

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## References

- Bithas, K., 2008. The European Policy on Water Use at the Urban Level in the Context of the Water Framework Directive. Effectiveness, Appropriateness and Efficiency. *European Planning Studies*, v.16, no. 9
- Frone, Simona, 2008. Factors and Challenges of Regionalization in the Water and Wastewater Sector, in *Romanian Journal of Economics* nr.2 (36)/2008
- Billi, A., Canitano G., Quarto A., 2005. The Economics of Water Efficiency: a Review of Theories, Measurement Issues and Integrated Models, in *Options mediterraneenes*, Series B, n°57
- Nauges Celine and van den Berg Caroline, 2008. Economies of density, scale and scope in the water supply and sewerage sector: a study of four developing and transition economies, in *J Regul Econ* (2008), 34
- Frone, Simona, 2012. Issues on the Role of Efficient Water Pricing for Sustainable Water Management, in *Romanian Journal of Economics* nr.1 (43)/2012
- Platon V., Dulcu G., 2004. "Country-Specific Issues and Proposed Tariff and Charge Reforms: Romania", in *Assessment and Development of Municipal Water and Wastewater Tariffs and Effluent Charges in the Danube River Basin*, UNDP/GEF DANUBE REGIONAL PROJECT
- Dalhuisen et al., 2003. Price and Income Elasticity of Residential Water Demand: A Meta-Analysis, in *Land Economics* 79(2)
- OECD, 2010. *PRICING WATER RESOURCES AND WATER AND SANITATION SERVICES* © OECD 2010
- INSE, 2011. *Romanian Statistical Yearbook.. Activities regarding public utility of local interest*, 2011
- Frone Simona, Frone D.F., 2012. Sustainable Water Pricing and Demand Management Issues in Romania, in "Ovidius" University Annals, Economic Sciences Series Volume XII, Issue 1 /2012