Papeles de Trabajo

EFFICIENCY IN WATER SUPPLY NETWORK.ERDF IMPACT EVALUATION. SPAIN (2007-2010)

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ABSTRACT

This paper studies the effect that water projects, financed by EU funds, have had on the efficiency of water distribution in the period 2007-2010. Using data from Spanish municipalities, we performed a descriptive analysis of the evolution from this period. Then, we study the impact that structural EU funds have on the efficiency in water distribution using the diff-in-diff approach. With different specifications of panel data, we calculate the impact that these projects have on the result variables under study. The estimation results show that ERDF co financed works have a significant effect in reducing the amount of water supplied per capita, as well as in terms of reducing water leakages, but the impact on the second variable is not as clear as the effect in per capita water distribution.

Key words: Impact evaluation, ERDF funds, dif in dif, water supply, water leakages, panel data.

JEL Code: C01, E32, H43, Q25, Q38, Q58.

1. INTRODUCTION

Water, as an essential element for life and ecosystems, is vital for the health of the planet. As a key resource to ensure quality of life, it must be managed according to criteria of rationality, efficiency and equality. Many countries are facing the challenge of having adequate and sufficient infrastructure networks to ensure access to safe drinking water and basic sanitation. In this sense, to ensure environmental sustainability, it has been chosen by the World Bank as one of the Millennium Development Goals, pointing out the difficulty to access to such services, which mainly affects rural areas. Nowadays, 2.5 billion people still lack access to sanitation.

The key element of water management is the protection of human health and the sustainable maintenance of related aquatic and terrestrial ecosystems. The state of water is not only determined by natural factors, such as geology or climate, but also by the pressure exerted by human actions such as urban, industrial and agricultural activities. Human activities cause pollution and water extraction, which give rise to an alteration of the physicochemical properties of water by modifying its natural flow. In addition, an intense use of this resource, by means of irrigation, can cause salinization.

According to the previous paragraph, Member States need a more strategic approach that takes into account sustainability in the use and management of water. The whole study regarding water has an ethical perspective that goes beyond the simple assessment of a resource as it involves intrinsic values and heritage characteristics. It is important to consider the sustainability paradigm and introduce the concept of functionality of river basins as a key to the recovery, management, and operational maintenance of the river. To restore and maintain watershed includes: ensuring the multiple functions of water and enabling their rational use, now and in the future. The result is a more sustainable development that integrates economic prosperity, social and territorial cohesion, and the recovery and conservation of environmental goods and services related to water.

Since climate change will have a negative impact on the sustainability of the use of water, it is necessary to adapt the management of water resources to what is expected for the future (Rossi and Castiglione, 2011), something that has already been taking into consideration at European level[1].

The ecological status of the water has become an essential objective of the European Union. The European Directive 2000/60/EC establishes a framework for Community action in the field of water policy, which includes, among other objectives to achieve good ecological and chemical status of all water bodies by 2015 (transposed to the Spanish Law by Article 129 of Law 62/2003). The main objectives of the European directive are:

- To promote sustainable water use based on long-term protection of available water resources.
- To ensure a balance between groundwater capture and recharge of groundwater bodies in order to achieve good water status by 2015.
- To achieve a good status of all kinds of water bodies by 2015.

For Spain, the efficient use of this resource is a key element, due to the special climatic characteristics that our country presents and in recent times, droughts have occurred both in Spain and in third countries. This has once again underlined the nature of water as a scarce but essential resource.

The difference between Spain and the most advanced countries in the field of water resources comes mainly from the quantity of water, except in the case of Israel, where the water scarcity is even deeper than in our country. But even assuming identical amount of water, there is a great difference on the efficient management of this resource. In other words, not only Spain has less water, but it seems that

[1] The impacts of climate change on terrestrial ecosystems in Spain over the next century will cause, on the one hand, the "mediterranization" of the northern Spain and, in the other hand, the "aridity" of the south, as a result of warming and reduction of water resources. Most of the indicators are pointing out immediate consequences like the increased temperatures and decreased precipitation and water flows in rivers. It is clear that the near future will be determined by climate change and its possible negative impact on water resources. This fact, together with the intensification of coastal construction and increased tourism, make more urgent a rational and intelligent manage of this strategic resource.

we care less about effectively managing it. There are now many studies that, focusing on this topic, have pointed out the consequences of the exploitation of natural resources in Spain.

The objective of analyzing water efficiency is that it focuses on reducing waste, not restricting its use. Water efficiency means reducing water wastage by measuring the amount of water required for a particular purpose and the amount of water used or delivered. To understand how to improve the water management, it is vital to study how the water supply systems work. The water system can be defined as the system responsible for ensuring the transportation and distribution of water from the collection points to the various points of consumption. In order to achieve this goal, active policies should be adopted. Some good examples, outlined in the Water Framework Directive are:

- the application of a tariff regime that internalizes the cost of water services;
- the use of water counters –including those for agriculture–;
- disclosure practices consumption;
- and sustainable employment.

Transposition and enforcement of the directives of wastewater and drinking water and the adoption of integrated management plans is part of the European compulsory legislation. The key objectives concerning the control and operation of all hydraulic systems are the following:

1. Control of the Water Quality and supply conditions.
2. Control of water loss.
3. Control of maintenance and operating costs of the service.

Therefore, one of the challenges is to continuously improve the effectiveness of the systems, i.e., that water attains the desired destination. Besides checking and analyzing the effectiveness of the system, it is also important to rigorously determine the efficiency with which the system achieves the objectives.

Once the first condition is fulfilled, which is the effectiveness of the hydraulic system; it is relevant to look at the responsiveness and adaptability that occur over time. A less efficient hydraulic system requires a greater volume of water resources than needed, and considering water as a scarce resource, the inefficiency generates serious worries, among other things, because it supposes higher energy consumption. Therefore, it is necessary and crucial to determine and quantify the causes that generate the problem through obtaining a detailed diagnosis.

In the field of urban water users (where 80% is domestic, 15% commercial and 5% public consumption) one of the most efficient ways of saving water seems to be in relation to the control and progressive reduction of loss that occur in distribution networks (Cabrera, 2004). The loss in the systems of water supply is mainly due to a number of factors (Arreguin and Buenfil, 1990):

- Evaporation and seepage occurred before water gets into storage vessels;
- Leakage in water treatment plants;
- Leakages in supply networks and home outlets;
- Imprecise measurements or to lack of it;
- Poor estimation;
- Unauthorized, illegal and uncontrolled taps.

Internationally, there are several studies that analyze the efficiency of water distribution, such as the works developed by Klasen and others (2011), Kolbl and others (2009) and Babic and Djukic (2011).At national level, the volume of water that is approximately unregistered is 28% of distributed water, which means that almost a third of the water sent through does not reach the point of consumption and therefore, it is not controlled or invoiced (Peñas, 2001). Set up programs for the management of demand is of special relevance concerning the unregistered waters (Covacho and others, 2000). In order to fix this problems, there are national programs whose main objective is the increase saving in consumption, as shown in the work of Estevan and Ballesteros (1997), that has been successfully applied in other countries (Skarda 1997).

According to the abovementioned results, it is crucial to increase the efficiency in the supply and distribution of water. Therefore both the EU, and Spain in particular, have strengthened their efforts by investing more over the last decade. The importance of investments co-financed by Structural Funds is derived from the political, social and economic importance of water as it is a renewable natural resource and a strategic factor in any development plan. According to the programming, the large volume of investments in this sector is shown in the following table:

Table 1

IMPLEMENTATION OF WATER INVESTMENTS FOR THE PERIOD2007-2013

			Programado		Ejecutado (AC+DE)		%ejecución	
Fondo	Objetivo	PO tema	Ayuda	Gasto	Ayuda	Gasto	Ayuda	Gasto
Cohesión	Cohesión	44	304.425.239	380.531.564	136.917.874,18	171.147.342,67	44,976%	44,976%
		45	456.876.085	571.095.117	167.886.287,95	209.857.860,16	36,747%	36,747%
		46	1.063.962.748	1.329.953.462	500.137.005,53	625.171.257,12	47,007%	47,007%
		Resto	1.717.948.936	2.147.436.117	1.411.930.098,29	1.764.912.622,96	82,187%	82,187%
		Total	**3.543.213.008**	**4.429.016.260**	**2.216.871.265,95**	**2.771.089.082,91**	**62,567%**	**62,567%**
		%44 s/Total	8,592%	8,592%	6,176%	6,176%		
		%45 s/Total	12,894%	12,894%	7,573%	7,573%		
		%46 s/Total	30,028%	30,028%	22,560%	22,560%		
FEDER	C Pura + Phasing out + Phasing In	44	100.063.288	123.666.870	35.512.158,01	43.961.718,52	35,490%	35,549%
		45	1.420.433.170	1.773.641.576	638.963.659,87	798.704.574,44	44,984%	45,032%
		46	940.762.164	1.175.952.706	418.384.380,00	522.980.475,22	44,473%	44,473%
		Resto	18.664.362.605	23.721.565.978	9.622.581.943,56	12.386.945.200,60	51,556%	52,218%
		Total	**21.125.621.227**	**26.794.827.130**	**10.715.442.141,44**	**13.752.591.968,78**	**50,722%**	**51,326%**
		%44 s/Total	0,474%	0,462%	0,331%	0,320%		
		%45 s/Total	6,724%	6,619%	5,963%	5,808%		
		%46 s/Total	4,453%	4,389%	3,904%	3,803%		
FEDER	Competitividad	44	2.000.000	4.000.000	0,00	0,00	0,000%	0,000%
		45					0,000%	0,000%
		46					0,000%	0,000%
		Resto	1.925.050.402	3.869.293.556	942.524.194,11	1.926.138.097,86	48,961%	49,780%
		Total	**1.927.050.402**	**3.873.293.556**	**942.524.194,11**	**1.926.138.097,86**	**48,910%**	**49,729%**
		%44 s/Total	0,104%	0,103%	0,000%	0,000%		
		%45 s/Total	0,000%	0,000%	0,000%	0,000%		
		%46 s/Total	0,000%	0,000%	0,000%	0,000%		
	TOTAL	44	406.488.527	508.198.434	172.430.032,19	215.109.061,19	42,419%	42,328%
		45	1.877.309.255	2.344.736.693	806.849.947,82	1.008.562.434,60	42,979%	43,014%
		46	2.004.724.912	2.505.906.168	918.521.385,53	1.148.151.732,34	45,818%	45,818%
		Resto	22.307.361.943	29.738.295.651	11.977.036.235,96	16.077.995.921,42	53,691%	54,065%
		Total	**26.595.884.637**	**35.097.136.946**	**13.874.837.601,50**	**18.449.819.149,55**	**52,169%**	**52,568%**
		%44 s/Total	1,528%	1,448%	1,243%	1,166%		
		%45 s/Total	7,059%	6,681%	5,815%	5,467%		
		%46 s/Total	7,538%	7,140%	6,620%	6,223%		

Source: Ministry of Finance, European Funds Direction.

The main objective of this work is to investigate whether those municipalities that have received EU funds to carry out a water collection or distribution work, have environmentally performed better than those municipalities that had not received funding. In addition, we will evaluate whether the improvement in water-related environmental variables of these municipalities is due to the finalization of the work funded by the EU or is due to other factors.

To do this research we propose to use the approach of “difference in differences”. The great advantage of this impact evaluation technique is that it eliminates the selection bias induced by unobserved permanent variables on the control and treatment groups. We analyze the parameter associated with the impact of such projects through a model of panel data for the period 2007-2010, using different specifications. This approach has been widely used in the impact assessment framework, such as the work of Duflo (2001), Galiani and others (2005) and Chay and others (2005). However, one of the main characteristics –and also a weak point– of this method, compared to alternative quasi experimental evaluation methods, is its information requirements, as it needs data for various time points.

The paper is structured in the following sections: In the next section we analyze the efficiency trend in water distribution in Spain by means of analyzing the most relevant indicators related to this topic. Section 3 explains the databases and the impact indicators used to assess the effectiveness of ERDF funds and the type of information (variables) available for the study. Section 4 focuses on proposing the most appropriate econometric technique for the evaluation study. The results of the analysis are shown in Section 5. Conclusions are in section 6.

2. EVOLUTION OF THE WATER EFFICIENCY INDICATORS IN SPAIN

In this section we analyze the relevant efficiency indicators for the impact estimation, and we study the time trend in water distribution in Spain by means of analyzing the time series in the last decade.

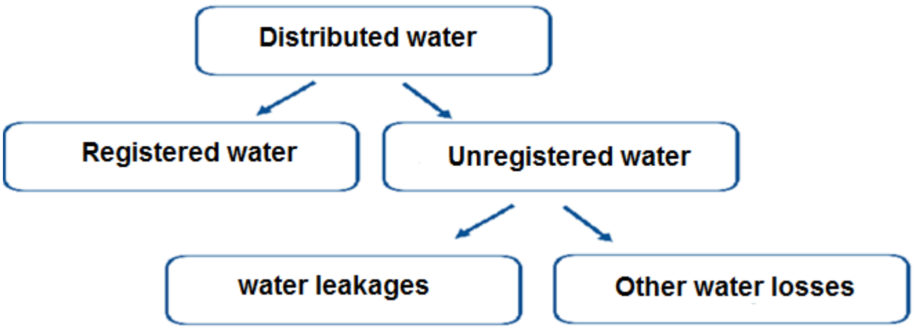
The next subsection presents a set of indicators that can be used to quantify the current efficiency in the water distribution network (for a more complete set of urban sustainability indicators see Sahely and others, 2005, and Guio-Torres, 2007).

2.1. Impact indicators

The volume of water that flows into the plumbing system should be continuously measured and recorded, as the design and diagnosis of supply and storage facilities is crucial. An accurate prediction of this value is essential to properly plan and exploit the whole supply both in the near future and in the long term.

Once the quantity of water discharged to the sanitation networks is properly measured, the next step is to specify the points of consumption, the volumes extracted and their use. The volume of water that flows into the network can be classified into two main groups, as shown in Figure 1[2]: registered and unregistered. The former has been measured by devices inserted in the pipelines of various consumers.

Figure 1
STRUCTURE IN WATER SUPPLY



The sum of both quantities is the total amount of water distributed. Thus, unregistered volume is calculated by taking the difference between the total volume discharged into the plumbing network and the volume registered. The formula for the volume of water distributed is as follows:

$$\text{Distributed\_Volumen}_{\text{total}} = \text{Volumen}_{\text{resgistered}} + \text{Volumen}_{\text{unregistered}}$$

The volume of water registered allows us to obtain the remaining volumes by subtracting quantities:

$$\text{Volumen}_{\text{unresgistered}} = \text{Distributed\_Volumen}_{\text{total}} - \text{Volumen}_{\text{registered}}$$

The total volume of water registered is the result of summing up the volumes recorded at different points of consumption, differentiated by their spatial location and their type of use. The unregistered

[2] Another interesting classification apart from the option given in Figure 1 is the kind of consumption, where we distinguish domestic, industrial, commercial, institutional and public consumption.

volume is analyzed based on the causes that prevent metering, as this knowledge allows us to adapt to look for different solutions according to various problems:

a) Water that is unregistered due to the absence of water counters at the point of consumption. In this situation, the solution is the installment of devices to control water consumption. The main advantages are listed below:

– Increase the volume of water whose destination is known and controlled.

– Avoid water wastage.

b) Volume registered due to fault and error in water counters is one of the main causes why some consumption is not recorded. Although this volume is not in itself any water loss it must be minimized, in order to share the cost of water service between more subscribers. It allows us to rigorously distinguish unregistered volume from real loss, which it may exceed 15% of the volume recorded.

c) Volume consumed in public use, such as water used in street cleaning, watering public gardens, public fountains, downloads in the sewer, fire fighting are called public consumption and are not usually recorded. This should be controlled and in many cases its value can be estimated either by periodic measurements of the flow or by counting the number of hours of use. Its magnitude is estimated at around 10% of total volume.

d) Unregistered Volume. This volume is a real loss. It is very difficult to quantify, except indirectly as the difference between the amount distributed and the other abovementioned volumes. This is why it is so important to measure the remaining volumes. It is also essential to analyze its components. This can be done by splitting them as follows:

- Water loss due to breakage in water supply network elements; mainly pipeline.
- Water loss through system defects, which are generally called leakages.
- Evaporation loss in deposits.
- Clandestine removals through illegal connections.

Once defined the various components in which the distribution of water can be separated, the most common way to measure the efficiency of water distribution is by two indicators: first the ratio of the quantity that measures the proportion that the total loss of water distributed, and the other indicator is what is known as volumetric efficiency. The volumetric efficiency of a network, or an isolated sector of it, is defined as the ratio of the volume of registered water divided between the total distributed water in the same period:

$$\eta_1 = \frac{\text{water leakages}}{\text{distributed water}} \qquad (1)$$

$$\eta_2 = \frac{\text{Registered water}}{\text{distributed water}} \qquad (2)$$

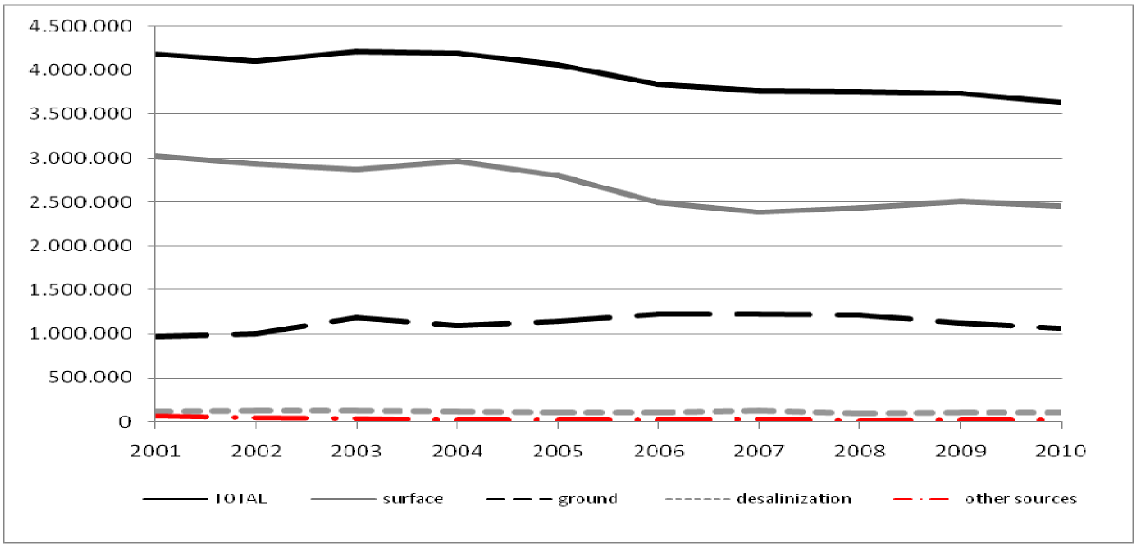
According to the value of the two ratios we can obtain a first diagnosis of the condition of the network. Focusing our study in urban water supply, one of the main ways of saving water seems to be related to a greater control and a gradual reduction of loss that may occur in the distribution networks. For this reason, the unregistered water has a special role to play in urban water management, concerning mostly ineligible water volumes. Being aware of the problem urban water managers have in recent years devoted a great effort to control or minimize this situation. The time trends for the coming years suggest that the management of unregistered water in urban water supply systems will represent a highly effective measure to globally help save water and besides the leaks, there are other important uncontrolled consumptions. Therefore, it seems reasonable to quantify the losses, regardless whether or not they have to pay for the water consumed. In this way the use and consumption of urban water shall be subject to greater efficiency (Peñas, 2001).

2.2. Evolution of the pumped and distributed water indicators in Spain

In this subsection we analyze the evolution of the key indicators related to the collection and distribution of water as well as the efficiency indicators in Spain in the last decade. Concerning the first set of variables, Figure 2 shows the time series of water uptake for urban supply depending on its origin.

Figure 2

EVOLUTION OF TYPES OF PUMPED WATER FROM 2001 TO 2010



Source: Spanish Statistics Institute, (INE).

According to the latest statistics published by the Spanish Statistical Institute, in 2010, total water distributed for urban purposes in Spain reached 3,635 hm3, of which 67% was surface water captured, 29% groundwater and so only almost 3% came from sea water desalinization.

Between 2001 and 2010 there was a reduction of 13% in the water uptake production. Among the different types of water, groundwater grew by over 10%, whereas surface water and desalination experienced a decrease of 19%and 11 % respectively. Summarizing, it should be noted that water production has decreased since 2003 mostly because of to the reduction in the use of surface water.

Once the water has been stored, the next step is to determine the amount of water available for supply[3]. The amount of water available for public urban supply allows public authorities to take into consideration the sustainability criteria. It also allows them to establish a relationship between the amounts of water available and the water needs of the population.

The water supplied is defined as the flow of water entering the distribution network either from water treatment plants or from service depots. It is classified as logged and distributed water by type of user (which includes only the volumes measured in meters). The unregistered water is the difference between the volume of water supplied to the public water systems and the volume of water recorded and distributed by type of user.

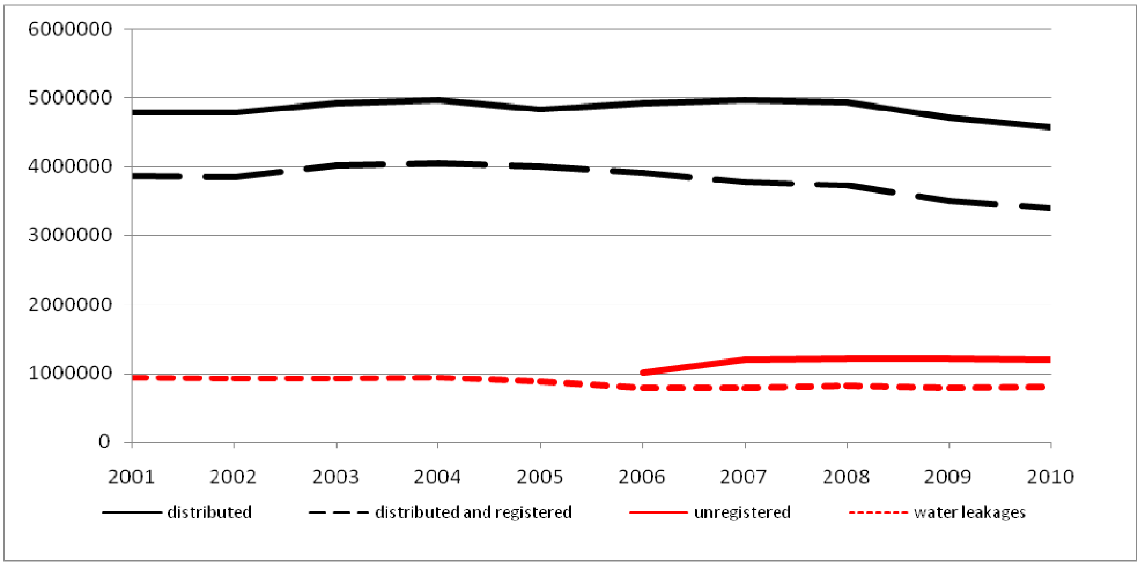
The indicator is related to the loss in the distribution network and its time trend is related to the efficient use of the resource. By reducing water loss and by establishing a proper control of consumption we establish a more efficient distribution system. Any measure towards this goal is key to

3 Definition of indicator for the water available for supply provides information, in absolute terms (hm3) and relative (liters / person/day) terms on the amount of water pumped from public water-supply networks.

improve sustainability in an urban resource use. It also reinforces the application of the principle of cost recovery included in the Water Framework Directive provisions.

Figure 3

EVOLUTION OF THE WATER SUPPLIED TO THE SYSTEM AND ITS COMPONENTS. PERIOD 2001-2010



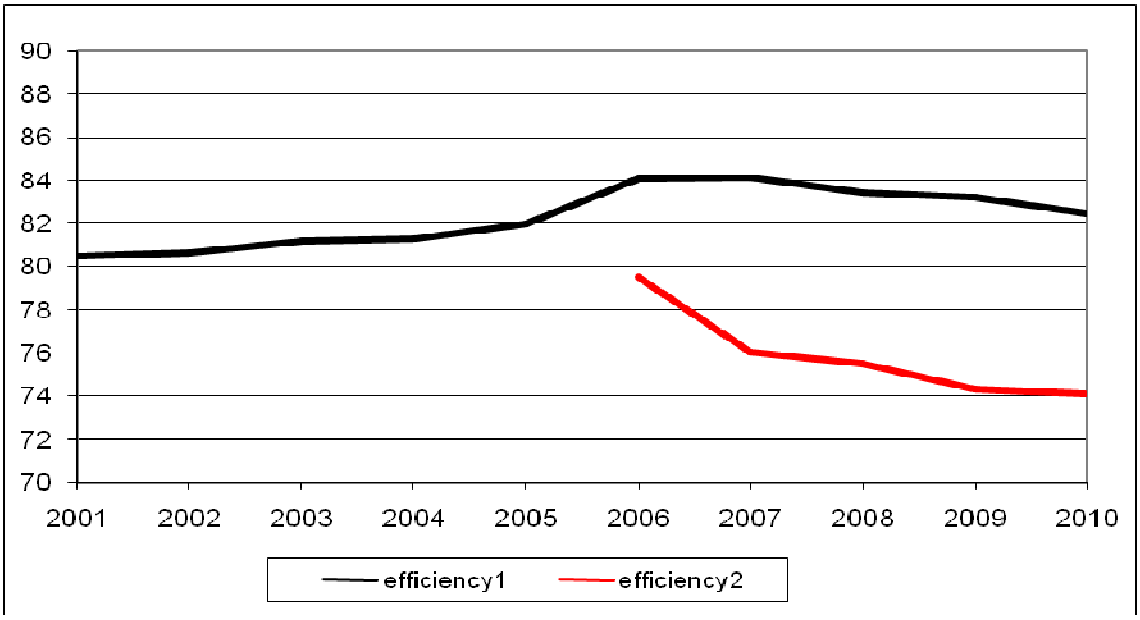
Source: Spanish Statistics Institute, (INE).

Figure 3 shows that there has been a clear improvement in the use of water during the last decade. This positive time trend has been achieved due to a more efficient use of water resources, as the improvement in the efficiency of distribution public networks supply didn't play an important role. However, over the past two years, loss in distribution networks has changed the trend from the previous downward trend to an upward one[4].The amount of public water supplied continued the downward trend experienced in recent years, reaching 4580 Hm3 in 2010. This means a reduction of 2.7% in comparison to the previous year. The water recorded and distributed to users was 3.393Hm3 for homes in the same year. Water loss in urban water supply due to leaks, cracks and faults in networks reached a value of 802 Hm3 in 2010, representing 17.5% of total water supplied to these networks, and it means a reduction of 1.4% over 2009.

The variable that better measures the efficiency of the distribution is given by the ratio between the total value of unregistered water and the total volume of water distributed. It is expressed as a percentage of total volume of water delivered as shown in equation (2). In this assessment, the "uncontrolled distributed water" does not include loss in internal consumption system collection, purification and distribution of water. Furthermore, we show another efficiency measure given by: "1- equation (1)", which includes only real loss in the numerator of the ratio.

[4] Another interesting result is the comparative evolution of the following variables: public distribution of water supply and gross domestic product (GDP). It shows a clear dissociation from 2001 to 2010 due to a decline in water consumption of different users (households, economic and public use).

Figure 4
EVOLUTION OF EFFICIENCY IN WATER SUPPLY



Source: Spanish Statistics Institute, (INE).

The efficiency ratio for public distribution networks[5] shows an average loss of 20% of the volume of water distributed for the whole period, experiencing a slight improvement during the past decade. However, there has been a clear behavioral change in the past seven years. Until 2006 there was an improvement in the efficiency of the system, and thereafter the degree of inefficiency increases, measured as "1 – the equation 1", named in the figure "efficiency1" and it presents similar results in the unregistered water" given in equation (2), named "efficiency2" in figure 4[6]. The uncontrolled water due to these errors is estimated at 18% of the total unregistered volume. According to these results, in order to analyze the impact of EU funds we will use two variables; we measure the degree of efficiency in the water distribution with two different variables:

— Variable 1: total distributed water per capita: log (distributed water volume / total population)

— Variable 2: efficiency indicator: (unregistered water volume / total water distributed)

In the next section we explain how the data has been obtained for the study.

3. DATABASE

In order to estimate the impact that the use of EU funds has on water efficiency we use two sources of information: on one hand, a Ministry of Finance database on the management of EU funds and, on the other hand, a water survey conducted by the Spanish Statistics Institute (INE).

The Ministry of Finance administrative file for the management of EU funds, conducted and managed by the European Funds General Directorate, contains information on beneficiaries of EU funds, dates of financial transfers and implementation, financial amount of the projects, amount of EU financial

[5] It is an indicator that measures the efficiency in the network management of public supply distribution. Reducing water loss and controlling water consumption increases the efficiency of distribution systems and it is a key issue to achieve a sustainable use of an urban resource. It also helps to implement the cost recovery principle as laid down in Directive Water Framework. This indicator is directly related to the indicator "Lost Water Distribution Network in Public Supply" of the European Environment Agency.

[6] In Spain, the control of urban water use by registered consumers is above 97%, but 19% of the water meters installed are older than 10 years and 37% are between 5 and 10 years' old. The age of the meters influences the readings margin of error.

assistance and so on. This database is an administrative census file which records all transactions and beneficiaries which have received ERDF support for any given project. It has information on both the 2000-2006 period and the 2007-2013, which is crucial for the management and the certification of payments. Table 2 includes all water treatment actions that have been completely implemented from 2003 until the latest available year, disaggregated by type of region.

Table 2

SHOWS ALL CONCLUDED WATER DISTRIBUTION PROJECTS FINANCED BY ERDF FUNDS

	Year of finish	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Type region	**CCAA**												
Competitiv.	Aragón	3	40	27	31	42	45	28	34	7			22
	Islas Baleares			3	2	6	1	5	3	6	2		3
	Cataluña		2	7	15	7	21	12	32	46	5		46
	Cantabria		6	3	5	4	6	1	1				
	La Rioja					1	2	1	1				1
	Madrid	1		1		3		1					
	Navarra					1	3	12	1				
	País Vasco		1					1		1			
Convergence	Andalucía	2	7	6	11	3	18	8	8	28	12	3	6
	Castilla la Mancha	20	53	60	41	7	8	8	6	7	2	8	
	Extremadura	15	1	4	2	4	1	6	3	5	7	12	
	Galicia		4	6	9	7	2	7	4	3	2	1	
phasing-in	Islas Canarias	1	3	3	6	8	4	1	3	1			
	Castilla y León	10	36	14	24	6	7	20	19	8	1		
	Comunidad Valenciana		2	4	7	8	6	11	29	13	11	7	1
phasing-out	Asturias		14	6	3	1	3	7	3	5	2		
	Murcia		1			27	9	6	7	6			
Total finished		52	170	144	156	135	136	135	154	136	44	31	79

Source: DG ERDF, Ministry of Finance.

Despite the extraordinary information contained in this administrative file, especially concerning matters regarding the management of these projects, it presents two problems. On one side, it does not offer any kind of information on our dependent variables of interest, i.e. the impact variables necessary to study the effectiveness of public interventions. Secondly, it does not allow us to look at a control group, i.e. a set of municipalities that did not undertake any water distribution network project, which is necessary for an impact evaluation analysis. Therefore, there is the need to have another source of statistical information that can be combined through matching techniques with the other file.

The second source of information, the Survey on Water Supply and Treatment, designed and conducted by the INE, provides yearly data on water use for the period (2007-2010). The main objective of the survey is to quantify in physical units and in economic magnitudes, activities, such as water supply and sanitation (sewage and wastewater),related to the water cycle. One of the great advantages of this survey is that it effectively covers for almost 85% of the Spanish population. This file provides information on:

- Water stored, disaggregated by inland surface Groundwater, Water Desalination and others.
- Total water supplied to the public water system.
- Water volume recorded and distributed by type of user.
- Total volume of water recorded in the distribution network.
- Real loss and apparent loss.
- Waste water treatment, sewage, biochemical oxygen demand (BOD5) and Chemical Oxygen Demand (COD).

The final file for impact effect estimation is generated by performing a microdata level matching between the beneficiaries file of the Ministry of Finance and the water supply and treatment statistical file of INE. The identifier of the municipality is the matching variable, 5 digit code that is unique to each municipality. After completing this process, the INE provides an anonymized microdata file providing information on different variables for the period 2007-2010. Table 3 shows on one hand, the common municipalities number, which will be our treatment group and, on the other hand, the mismatched control group between for both files during different years:

Table 3
MATCHING BETWEEN DG ERDF FILE AND WATER SURVEY OF INE

Type of municipality after matching	year 2007	year 2008	year 2009	year 2010
Treatment group (in both files)	679	655	672	715
Only in the Ministry of Finance file	857	897	887	840
Control group (only in INE survey)	1557	1529	1604	1725
Related Spanish population	44.19	44.75	45.67	45.58

Source: DG ERDF funds and Spanish Statistics Institute, (INE).

The information included in the final matrix arises from the intersection of the two files: the General Directorate file and the INE file. The result is a database containing control and treatment group that can be used to carry out an impact assessment study. In addition, a refinement of the data sample has been finalized. After the exact matching of the two files, INE provides a microdata file, which contains municipalities in either the control or the treatment group. However, it is necessary to make a statistical depuration effort of this initial database because these two groups are not correctly identified, and it is necessary to locate exactly which municipalities were going to be split up between the control and treatment groups.

This second step is very important because the General Directorate administrative file of the Ministry of Finance shows misleading data (bearing in mind that the INE provides information only for the years 2007 to 2010). It is essential to overcome the problem of municipalities that erroneously were assigned to the control group, which didn't perform any distribution network investment. This is because the administrative data file used in this work from the Ministry of Finance has available information only for those municipalities that perform project supported by European funds, but it doesn't have any information concerning those municipalities that implement distribution network projects using other non-European types of assistance (national, regional). In this situation we may wrongly consider those municipalities as individuals in the control group while, in fact, they have carried out water distribution network works.

Therefore, the existence of these fake control municipalities in our data sample may distort the results. Due to this reason it has been requested to the Ministry of Agriculture (MAGRAMA) a census file of the municipalities that have performed any waste water treatment project in the years of study, regardless of their source of funds. After matching the files, we have proceeded to remove from our database all those municipalities that were included in our initial control group, but which had done some distribution network works according to the information provided by the Ministry of Agriculture's file.

After this procedure, we focus in the different characteristics of the municipalities and regions. The most important are the impact variables there are two dependent variables at municipal level:

(1) (Distributed water volume / total population), and

(2) (Unregistered water volume / total volume distributed).

Apart from the impact variables, there are other municipal-level variables that could affect the impact variable such as:

– Population of the municipality in the reference year

– Proportion of women to total municipality population

One of the main advantages of this work is the possibility of taking into consideration the effect that the regional context has on EU funds. Other studies of investment funds, like Decastris and Pellegrini (2007) and Gadd, Hansonn and Mansonn (2009), pointed out that several workslacked a geographical and spatial dimension of the analysis. For that reason, this study aims at investigating whether the regional environment affects these kind of projects financed by EU Funds. At the regional level, one of the most relevant variables to take into consideration is the national co-financing rate, which differs among regions depending on their relative wealth. In the 2007-2013 programming period the regional policy legislation distinguished four types of regions eligible for different co-financing rates:

- Convergence regions: 80% of ERDF co-funding.
- Phasing in regions: 80% of ERDF co-funding.
- Phasing out regions: 80% ERDF co-funding.
- Competitiveness regions: 50% of ERDF co-funding.

Bearing this in mind, the characteristics of the regions considered in this work can be classified according to three different criteria:

– Type of region according to EU regional legislation:
  - Dummy: Takes value 1 if the municipality region belongs to a pashing-in or convergence region; and otherwise 0.

– Climate Variables
  - Hours of sunshine per year.
  - Volume of rain per year.
  - Annual average temperature.
  - Annual average humidity of the region.

– Economic variables
  - Average worker wage
  - Gross Value Added of the Economy.
  - Industrial sector GDP
  - Agricultural sector GDP
  - Energy sector GDP
  - Construction sector GDP.

Table 4 shows the descriptive statistics, differentiating between control and treatment group. The data reflect average values calculated for the period 2007-2010.

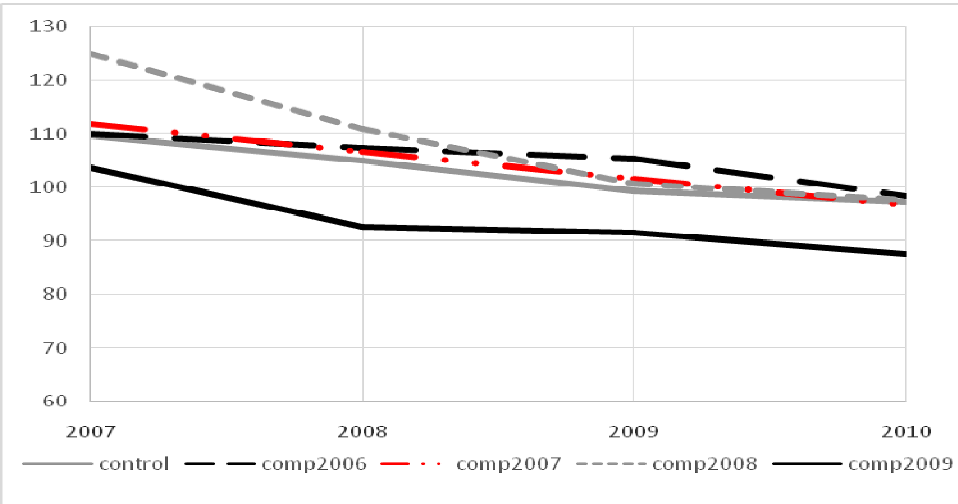
Table 4
DESCRIPTIVE STATISTICS OF THE VARIABLES

	Total mean	st. Deviation	Control mean	st. Deviation	Treatment mean	st. Deviation
unregist. water	2.611.884	9.717.177	2.585.367	955.263	2.724.578	1.031.462
Distr water perca	1.031.243	3.445.563	1.026.849	3.412.791	1.049.975	3.576.918
Population	18589.38	89092.98	17660.57	96726.51	22538.46	43465.89
population2	7.91e+09	2.27e+11	9.32e+09	2.52e+11	1.91e+09	1.01e+10
Agricultura	2457976	1739256	2448256	1763401	2499304	1632465
Energy	2483116	1469062	2576081	1484332	2087850	1332097
Industry	1.31e+07	1.07e+07	1.35e+07	1.07e+07	1.10e+07	1.02e+07
Construcción	1.04e+07	6380280	1.07e+07	6384890	9052363	6179431
GDP	1.04e+08	6.87e+07	1.08e+08	6.92e+07	8.74e+07	6.43e+07
Temperatura	1.624.565	2.229.644	1.614.544	2.190.713	1.668.109	2.342.881
sun hours	2.577.654	4.214.341	2.554.614	4.343.696	2.670.782	3.494.868
Rain	5.806.494	2.789.223	5.895.007	2.832.661	5.414.309	2.552.145
Humidity	5.690.463	1.192.729	5.695.423	118.771	5.668.911	1.214.432
femalerate	.4917667	.0204096	.4911357	.0211139	.4944495	.0168372

Source: Own elaboration.

Finally in this section, we have taken into account the behavior of the result variables of this work, we study the temporal evolution of the dependent variables. The first results shown in Figure 5 are the average values of the variable (distributed water volume / total population) for the four years of information provided by the INE, and depending on which year the work in distribution network has been completed.

Figure 5
EVOLUTION OF THE VARIABLE (DISTR VOLUME / TOTAL POPULATION). PERIOD 2007-2010



Source: Own elaboration.

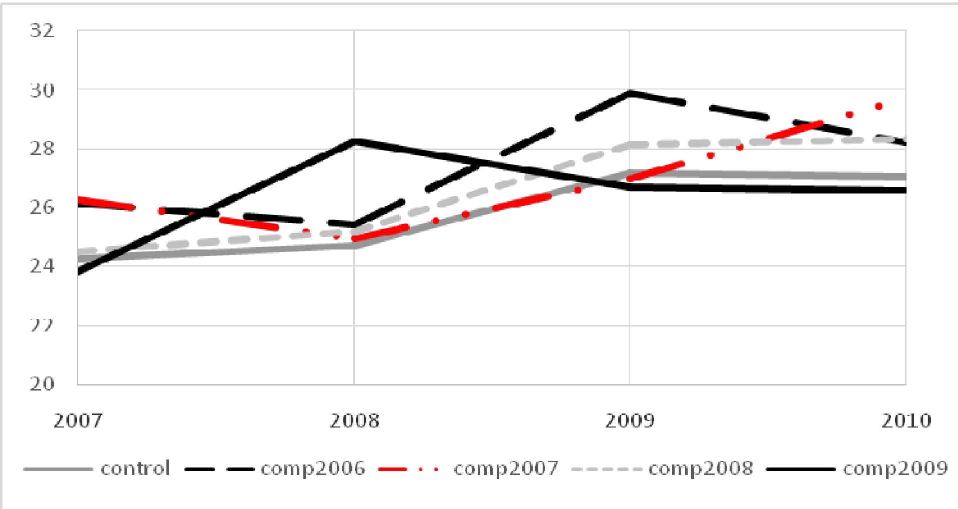
Those municipalities that did not undertake any project (or when they did, it was after 2010) are considered the control group. Those implementing projects that started in 2006 or earlier and were finalized in 2007 to 2009 are considered the treatment group.

The results show that, in all cases, there was a reduction in the amount of water supplied per capita, regardless of type of municipality. The decline is deeper for those municipalities which have done some work in comparison to those in the control group. This Figure is a confirmation that projects co financed by ERDF funds have had the effect of reducing the amount of water supplied. However, since this study has not been done controlling other explanatory variables as it is not a strict dif-in-dif assessment (different years of treatment) it is not possible to get a statistical difference of means, which would have allowed us to contrast this first graphic result.

The other possible efficiency analysis relies on the ratio (unregistered water / water distributed). Figure 6 provides, similar to the previous figure, the evolution of this variable for the four available years of data and also depends on the year in which the municipal project will start functioning.

Figure 6

EVOLUTION OF THE VARIABLE (UNREGISTERED WATER / TOTAL WATER DISTRIBUTION). PERIOD 2007-2010



Source: Own elaboration.

Contrary to what happened with the previous dependent variable, in this case it is not visually easy to offer a statement similar to what was found before. It seems that, in every case, the amount of water reflects peaks in different moments of time depending on the timing of the completion of the project. For this reason, we are not able to make a distinction in the behavior of the control and the treatment groups.

According to the previous results, we have consider a cuasi-experimental analysis, taking into account the possible existence of a selection bias in the municipalities. In the next section we propose an estimation method to sort out this problem.

3. IMPACT ESTIMATOR: ECONOMETRIC METHOD

The biggest challenge in the evaluation of any kind of intervention or program is to obtain a reliable estimate of the so called counterfactual: what would have become if the participating units had not participated? Without a credible answer to this question, it is not possible to determine whether the intervention has actually influenced the results of the participants or not. However, as the name suggests, it is impossible to observe the opposite situation, which can only be estimated. In this situation, without a valid comparison group, it is not possible to attribute to the program the effects that we are evaluating. One of the main problems in order to obtain a suitable control group is the selection bias, with a non random assignment of participants to a program. To remove these biases, we have to build a valid comparison group. In this paper use one of most common techniques in impact assessments analysis: the difference-in-difference approach.

The method of differences-in-differences allows us to estimate the impact by combining two strategies. The first strategy consists of subtracting the efficiency value of water distribution before the project starts from its value some time after it has been finished for the municipalities participating in the project. The strategy of comparing the earlier with the later has the advantage that only participating municipalities have been assessed, so we avoid the problem of comparing municipalities with different features. At the same time, it has the disadvantage that the environmental and macroeconomic conditions in different moments of time may differ between the value of the result variable before and after the public intervention.

The strategy of comparing the efficiency of water distribution between the participating municipalities and the nonparticipants is almost the opposite: the difference in the macroeconomic conditions is not an issue, but the fact that we compare municipalities with different characteristics becomes its weakest point. Therefore it is not surprising that, by combining these two strategies, we are able to compensate and balance their strengths and weaknesses. Due to that, the method of differences-in-differences gives us the possibility of estimating the impact in a more efficient way by combining two strategies which by themselves wouldn't be sufficient.

The aim is to identify and estimate the average effect of ERDF funds on the efficiency of water distribution in those municipalities which have received European funds (i.e., the average impact of the treatment on treated). In formal terms, the variable of interest has the following potential outcomes, level of efficiency Y_1 and Y_0 , depending on a number of observed explanatory variables X and the unobserved variables u_1 and u_2 .

$$Y_{1t} = g_1(x) + u_{1t} \quad \text{y} \quad Y_{0t} = g_0(x) + u_{0t} \qquad (3)$$

Where Y_{1t} is the efficiency level in water distribution for a given municipality in year "t" which has undertaken a work co-financed by ERDF and Y_{0t} is de efficiency level in water distribution for a nonparticipant (not undertaking any work in water distribution networks) municipality in the same moment of time "t". The functions $g_1(x)$ and $g_0(x)$ need to be estimated.

We estimate the influence that the implementation of a project co-financed by ERDF has had on efficiency for the group of municipalities i = 1, ..., N observed along the time horizon t = 1, ... T. Let's assume that the functions are not stochastic g_1 and g_0. Now, the parameter of interest is given by

$$\alpha = E(Y_{1t} - Y_{0t}|X, D = 1) = E(|X, D = 1) = g_1(X) - g_0(X) + E(u_{1t} - u_{ot}|X, D = 1) \qquad (4)$$

D_{it} , the dummy function, takes the value 1 if the municipality "i" undertakes a water distribution project at the time "t", and zero otherwise. The parameter α may change over time and, in this case, we may define our parameter of interest using the expectation operator over time and by the possible effect of $u_{1t} - u_{ot}$. Let's define the "t'" the pretreatment period and "k" where k> t' as the period of treatment. Then, equation (4) can be written as:

$$E(|X, D = 1) = E\big((Y_{1t} - Y'_{1t}) - (Y_{0t} - Y'_{0t})\big|X, D = 1\big) \; for\; all\; t \geq k$$

However, E (Y_{0t} | X, D = 1) is not observable and must be estimated using data provided by those municipalities that have not undertaken ERDF co-financed project. In this case, we replace this quantity by its counterfactual. Thus, the estimator is given by:

$$\alpha = E(Y_{1t} - Y'_{1t}|X, D = 1) - E\big((Y_{0t} - Y'_{0t})\big|X, D = 0\big) \; for\; all\; t \geq k$$

A key element is that those municipalities that have decided to implement a project may differ from those which haven't, and these differences are correlated with the efficiency of water distribution. For example, wealthier areas where efficiency rapidly increases are those that have done some works. In this case, the correlation between implementing works and the efficiency in the water distribution can be altered by introducing the effect of wealth in the equation. In principle, this type of unobservable identification problems can generate real effects that can beconsidered fixed characteristics in the long term. This general specification of the diff-in-diff estimator is calculated using a panel data model that considers both time effects and individuals in the assumption that the efficiency in water distribution differs only by a constant α

$$Y_{it} = \alpha D_{it} + \beta X_{it} + \lambda_t + \mu_i + u_{it} \quad (5)$$

X_{it} is the vector of the subset of explanatory control variables, that could change between units over time, μ_i is the time invariant effect for the municipality "i", λ_t is the time effect common to all municipalities. u_{it} is the error term of the municipality that varies over time, and it is independently distributed across municipalities and time, and is independent of μ_i and λ_t (see Chamberlain, 1984, and Heckman and Robb, 1985).

The difference in difference estimator of equation (5) is one of the most commonly used in the impact assessment literature (see, among others, Angrist, 1995, and Heckman and others 2000). The model assumes that the effect that ERDF co-financed projects have on the efficiency of the distribution is homogeneous along different municipalities[7].

5. RESULT ESTIMATIONS

In this section we present the estimation of the effect that water distribution works financed by ERDF funds have had on efficiency.

In order to give an estimate of the effect that water distribution works have had on the efficiency of water distribution we econometrically analyze this causal relationship by adding other explanatory variables to the study. Therefore, based on equation (5) we can work on 5 types of specifications depending on the variables to be considered in the study:

- Reg 1: without including a vector of other explanatory variables. Fixed effects model.
- Reg 2: Including vector of explanatory variables. Fixed effects model.
  - Re g3: Considering that the participating variable is endogenous. Fixed effects model with instrumental variables.
- Reg 4: Existence of AR (1) in the model by including the lagged endogenous variable as explanatory. GMM Estimation[8]
- Reg 5: similar to Reg 4, but assuming that the treatment variable is endogenous. GMM estimation.

The results of the serveral estimates are shown in Tables 5 and 6, including the p-value of the parameter estimation, including fixed effects for municipalities and years. Table 4 shows the results for the dependent variable for each of those cases (Total water delivered / total population).

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[7] However, when the effect of treatment on the treated is not homogeneous among municipalities, the estimator of diff-in-diff can have two types of biases (Heckman and others, 1997, and Heckman and others 1998). The first bias occurs when there are municipalities that implement works for which there are no similar municipalities in the control group. The second bias is due to the existence of different distributions of X within two existing municipality groups (control and treatment).

[8] In this case, the specification of the equation is given by:

$$Y_{it} = \gamma Y_{it-1} + \alpha D_{it} + \beta X_{it} + \lambda_t + \mu_i + u_{it}$$

Now, we have a new explanatory variable in the right hand side of the equation, and it is the lagged dependent variable. This kind of model cannot be estimated by static panel models anymore. It is necessary to use GMM methods (for more details see Arellano and Bond, 1991).

Table 5

EFFECT OF THE EXECUTION OF PROJECTS IN THE LOG DISTRIBUTION (SUPPLY / POPULATION). PANEL DATA ESTIMATION OF EQUATION (5)

	reg1 Parameter	p-value	reg2 Parameter	p-value	reg3 Parameter	p-value	reg4 Parameter	p-value	reg5 Parameter	p-value
treated	-0,007	0,400	-0,023	0,009	-0,023	0,007	-0,302	0,248	0,056	0,192
inefic-lag							0,837	0,356	0,068	0,591
Year07			0,129	0,000	0,132	0,000				
Year08	-0,023	0,000	0,105	0,000	0,111	0,000	-0,149	0,667	0,158	0,001
Year09	-0,082	0,000					-0,192	0,599	0,135	0,006
year10	-0,115	0,000	0,021	0,018	0,026	0,004				
Population			-8,6E-06	0,000	-8,8E-06	0,000	3,9E-07	0,839	-1,3E-06	0,000
population2			5,8E-13	0,251	2,4E-13	0,630	-5,5E-13	0,739	9,2E-13	0,066
Agriculture			-1,6E-07	0,000	-1,6E-07	0,000	3,4E-08	0,925	2,5E-07	0,008
Energy			1,1E-07	0,013	1,1E-07	0,012	-8,8E-09	0,991	-4,6E-07	0,015
Industry			3,4E-08	0,000	3,5E-08	0,000	5,3E-08	0,488	-2,3E-08	0,003
construction			1,9E-08	0,027	1,8E-08	0,032	8,0E-08	0,743	-1,2E-07	0,004
GDP			-2,7E-08	0,000	-2,8E-08	0,000	-1,6E-08	0,715	2,0E-08	0,006
Temperature			0,050	0,000	0,049	0,000	5,8E-04	0,983	0,011	0,240
Sun			-7,7E-05	0,003	-7,6E-05	0,004	4,4E-04	0,782	-0,001	0,000
Rain			-1,7E-04	0,000	-1,7E-04	0,000	-1,1E-05	0,977	-1,9E-04	0,273
Humidity			0,001	0,166	0,001	0,145				
Femalerate			-0,087	0,853	-0,089	0,851				
Constant	4,661	0,000	6,208	0,000	6,079	0,000	-0,063	0,993	6,512	0,000

Source: Own elaboration.

The estimation of the parameters associated with the variable "treated" reflects the effect that the policy has had on our variable of interest. According to the table, the fact of undertaking a water project has had an effect, as the parameter has a negative sign in most cases, meaning that the amount of water supplied per capita has been reduced. However, the impact is small as the estimate is statistically different from zero only in two situations (options reg3 and reg2).

Apart from the analysis of this variable, there are other characteristics that are relevant in order to explain the trend of the amount of distributed water per capita. Dummy variable for different years, the municipality's population, the GDP in Agriculture and other activities, like industry and services and the amount of rainfall and the sun hours of one year reduces the amount of distributed water, and the existing average temperature increases the amount of water supplied. Furthermore, it appears, in view of the results obtained, that the inclusion of the equation autoregressive process does not increase the explanatory power of the model, as seen in the estimates associated with variable "inefic-lag". As regards the effects that the completion of a work of water distribution has on the second variable that analyzed the efficiency (unregistered water / water distributed) the estimates are shown in Table 6.

Table 6

EFFECT OF DISTRIBUTION PERFORMANCE OF PROJECTS (WATER NOT REGISTERED/ WATER DISTRIBUTED). PANEL DATA ESTIMATION OF EQUATION (5)

	reg1 Parameter	**p-value**	**reg2 Parameter**	**p-value**	**reg3 Parameter**	**p-value**	**reg4 Parameter**	**p-value**	**reg5 Parameter**	**p-value**
Treated	-0,180	0,530	-0,512	0,165	-0,518	0,10	-0,397	0,780	-0,342	0,084
inefic-lag							-0,665	0,823	0,245	0,000
Year07	-2,414	0,000	3,061	0,002	3,086	0,002				
Year08	-1,917	0,000	-3,186	0,000	-3,131	0,000	0,357	0,983	-2,413	0,012
Year09							1,692	0,918	-1,414	0,113
year10	-0,179	0,360	0,162	0,670	0,206	0,592				
Population		3	-2,2E-06	0,851	-3,3E-06	0,775	-7,4E-05	0,725	-1,0E-05	0,026
population2			-2,2E-11	0,328	-2,4E-11	0,272	7,1E-11	0,734	8,3E-12	0,039
Agricultur			-1,6E-05	0,000	-1,6E-05	0,000	-1,5E-05	0,760	1,6E-07	0,942
Energy			-3,9E-06	0,036	-3,9E-06	0,036	2,2E-05	0,791	-1,3E-06	0,775
Industry			-1,2E-06	0,000	-1,2E-06	0,000	-3,0E-06	0,804	3,1E-07	0,021
Construction			6,1E-07	0,089	6,1E-07	0,091	-1,5E-07	0,987	-7,0E-08	0,933
GDP			9,2E-07	0,000	9,2E-07	0,000	2,3E-07	0,901	-6,1E-09	0,967
Temperature			-0,059	0,857	-0,068	0,838	-1,584	0,746	0,041	0,870
Sun			-0,004	0,000	-0,004	0,000	0,001	0,983	0,008	0,084
Rain			-0,003	0,004	-0,003	0,003	-0,025	0,839	0,006	0,148
Humedit			0,166	0,000	0,166	0,000				
Female rate			-40,296	0,048	-40,317	0,048				
Constant	27,241	0,000	23,221	0,229	22,126	0,253	74,910	0,813	-3,018	0,661

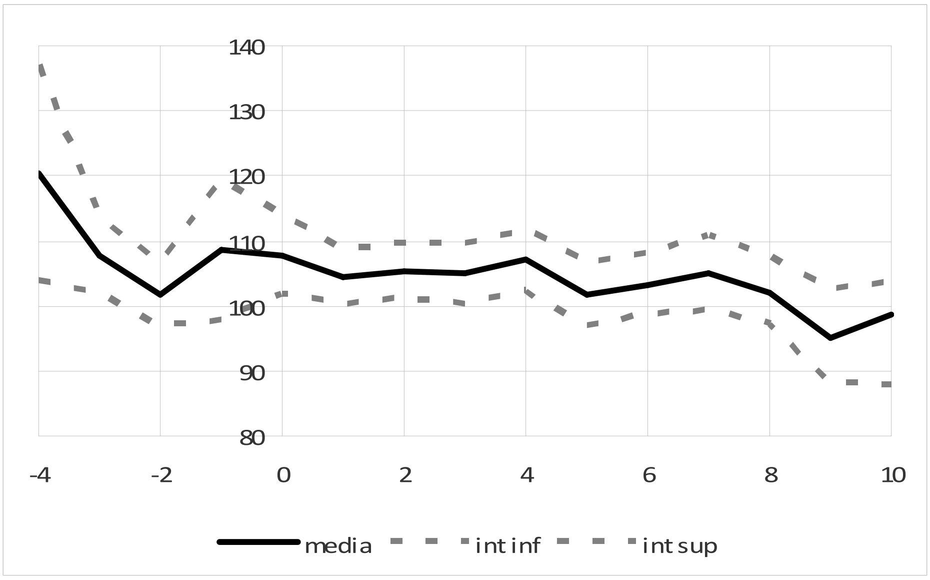
Source: Own elaboration

In this situation, and similarly to that seen in Figures 5 and 6, the impact of the policy is not statistically significant except in reg3 and Reg5 options. These values indicates that the distribution performance of municipalities with projects financed with ERDF funds increase the distribution efficiency, since it has a negative sign in all the proposed specifications, but the effect cannot be considered significant from a statistical point of view in most of the cases. Adding to this, we can point out that according to the results of this table, it appears that other variables, such as dummy variable for the year, production in agriculture, industry, energy, construction, or weather variables, especially the numbers of sun hours and the annual rainfall have a great influence on the results. In this case, the regression with an AR (1) structure increase the explanatory power of the model.

Finally, the last result estimation of this work is the study of the cumulative effect associated with this type of co-financed work, and instead of estimating the impact between before and after (and between treatment and control groups) we estimate whether there is a cumulative effect on the increase in distribution efficiency. To do this, we study the efficiency value of water distribution in the year in which the project financed by ERDF funds was completed. Figures 7 and 8 show the evolution of the two variables of interest, based on the difference between the year of the information and the moment of time when the project is completed. In order to do so, for these cases we consider only the municipalities that have undertaken some projects, i.e., the treatment group.

Figure 7

EVOLUTION OF THE MEAN LOG (WATER DISTRIBUTION / POPULATION) DEPENDING ON THE YEAR OF INFORMATION - YEAR FINISHED DISTRIBUTION WORK. CONFIDENCE INTERVALS AT 95%

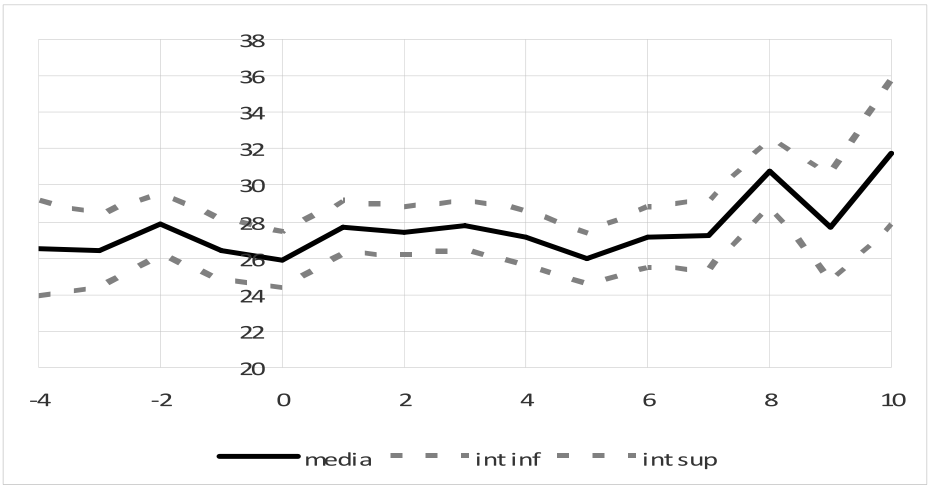


Source: Own elaboration.

The results show that there is a clear downward trend in the volume of water distributed per capita, but unfortunately, there is no observed breakpoint around the year 0. In addition, over the first years, having completed work, there are no significant differences in the amount of water distributed per capita, and it is only from the fourth year when there is a significant decrease in the water distributed variable. As regards the second variable which analyzes the distribution efficiency, Figure 8 shows the evolution around the year in which the project was fully completed for the dependent variable (unregistered water / water provided).

Figure 8

EVOLUTION OF (UNREGISTERED WATER / WATER DISTRIBUTED) DEPENDING ON THE YEAR THAT DATA IS AVAILABLE - YEAR FINISHED DISTRIBUTION WORK. . CONFIDENCE INTERVALS AT 95%.



Source: Own elaboration.

The effectiveness of the implementation of ERDF funds on the variable (unregistered water / water distributed) is not clear. In this case, the fact of implementing the policy does not appear to have a significant effect on the evolution of the unregistered water, and even when we look at the situation seven years later, the inefficiency of the system has increased.

In order to incorporate heterogeneity in the impact of the ERDF funds on efficiency result variables we modified the regression model described in (5) adding new elements to estimate a parameter for each of the years after the completion of the distribution project. This new specification allows us to observe whether there are different effects over time and not a common effect as estimated in equation (5). In this case, the equation of interest is:

$$Y_{it} = \sum_{r=1}^{6} \alpha_r D_{it} + \beta X_{it} + \lambda_t + \mu_i + u_{it} \qquad (6)$$

The estimator α_r indicates the effect that the completion of a water supply project has had on our variable of interest once there have been "r" years since the end of construction. Therefore, there are 6 new explanatory variables for the different periods considered after finished the works. Table 7 shows the results that the implementation of the work has on the *percapita* water supply.

Table 7

EFFECT OF THE COMPLETION OF PROJECTS HAS HAD ON THE LOG DISTRIBUTION (WATER DISTRIBUTED/POPULATION). PANEL DATA ESTIMATION OF EQUATION (6)

	reg1 Parameter	p-value	reg2 Parameter	p-value	reg3 Parameter	p-value	reg4 Parameter	p-value	reg5 Parameter	p-value
treatpost1	-0,016	0,383	-0,041	0,028	-0,042	0,023	2,831	0,454	3,279	0,352
treatpost2	-0,011	0,553	-0,028	0,130	-0,030	0,104			1,220	0,835
treatpost3	-0,017	0,373	-0,032	0,107	-0,032	0,106	0,237	0,693	0,827	0,681
treatpost4	0,009	0,639	-0,019	0,333	-0,020	0,304	1,843	0,778	1,571	0,271
treatpost5	-0,015	0,406	-0,022	0,266	-0,020	0,312	1,212	0,708	1,435	0,052
treatpos678	-0,001	0,896	-0,019	0,062	-0,021	0,045	-0,386	0,868	-1,002	0,409
inefic-lag							0,415	0,427	0,395	0,244
Year07			0,130	0,000	0,132	0,000				
Year08	-0,023	0,000	0,105	0,000	0,112	0,000	-0,138	0,715	-0,170	0,383
Year09	-0,082	0,000					-0,111	0,446	-0,124	0,270
year10	-0,115	0,000	0,021	0,022	0,026	0,005				
Population			-8,6E-06	0,000	-8,8E-06	0,000	-1,2E-06	0,559	-1,2E-06	0,385
population2			5,8E-13	0,250	2,4E-13	0,629	9,3E-13	0,573	8,2E-13	0,529
Agriculture			-1,6E-07	0,000	-1,6E-07	0,000	6,6E-08	0,585	1,2E-07	0,671
Energy			1,1E-07	0,013	1,1E-07	0,013	-1,4E-07	0,569	-1,1E-07	0,588
Industry			3,4E-08	0,000	3,4E-08	0,000	4,9E-08	0,761	7,8E-08	0,464
Construction			1,9E-08	0,024	1,8E-08	0,029	6,6E-08	0,814	8,8E-08	0,297
GDP			-2,7E-08	0,000	-2,7E-08	0,000	-1,2E-08	0,828	-2,0E-08	0,468
Temperature			0,050	0,000	0,049	0,000	-0,005	0,922	0,012	0,877
Sun			-7,8E-05	0,003	-7,7E-05	0,003	6,8E-05	0,874	1,2E-04	0,599
Rain			-1,7E-04	0,000	-1,7E-04	0,000	1,3E-04	0,626	1,4E-04	0,468
Humidity			0,001	0,177	0,001	0,155	-0,012	0,605	-0,013	0,160
Female rate			-0,080	0,866	-0,081	0,863				
Constant	-4,662	0,000	6,196	0,000	6,067	0,000	3,438	0,183	3,160	0,294

Source: Own elaboration.

According to the previous table, variable "treatpost1" indicates the effect in the dependent variable after one year of finishing the works financed with ERDF funds. The other variables have a similar meaning. Now, we observe that there is an increase in efficiency but it is important to highlight that this increase in efficiency is not statistically significant in several cases, apart form specifications 2 and 3, and it looks that the effect is fading when time passes, because the value of the parameter estimate decreases as the time difference, respect to the year of completion increases.

Concerning the effect that time has on the amount of water not registered as percentage of total water supplied, Table 8 provides estimates established for various regressions.

Table 8

EFFECT OF COMPLETING PROJECTS ON WATER NOT REGISTERED / WATER DISTRIBUTED. PANEL DATA ESTIMATION OF EQUATION (6)

	reg1 Parameter	p-value	reg2 Parameter	p-value	reg3 Parameter	p-value	reg4 Parameter	p-value	reg5 Parameter	p-value
treatpos1	0,296	0,651	0,166	0,834	0,145	0,854	9,834	0,800	-0,374	0,911
treatpos2	-0,274	0,678	-0,347	0,669	-0,371	0,647	2,079	0,825	1,119	0,544
treatpos3	0,508	0,481	-0,257	0,767	-0,270	0,755			-0,926	0,945
treatpos4	-0,597	0,404	-1,166	0,177	-1,188	0,169	3,238	0,900	-0,911	0,622
treatpos5	-1,138	0,087	-0,937	0,278	-0,933	0,280	-0,402	0,753	-1,258	0,133
treatpos678	0,035	0,919	-0,581	0,194	-0,593	0,185	0,627	0,822	-3,445	0,954
inefic-lag							0,074	0,955	-0,039	0,910
Year07	-2,414	0,000	3,014	0,002	3,043	0,002				
Year08	-1,912	0,000	-3,185	0,000	-3,118	0,000	0,960	0,951	-0,403	0,894
Year09							-0,571	0,946	0,031	0,983
year10	-0,160	0,413	0,192	0,615	0,219	0,569				
Población			-2,2E-06	0,847	-3,3E-06	0,776	1,1E-04	0,839	-7,5E-06	0,806
poblacion2			-2,2E-11	0,326	-2,5E-11	0,270	-1,2E-10	0,840	6,9E-12	0,800
Agricultura			-1,6E-05	0,000	-1,5E-05	0,000	2,2E-05	0,828	1,6E-06	0,770
energ_a			-3,9E-06	0,036	-3,8E-06	0,040	4,6E-06	0,796	2,8E-06	0,411
Industria			-1,1E-06	0,000	-1,1E-06	0,000	5,7E-06	0,842	-8,5E-08	0,958
construcc_n			6,0E-07	0,099	5,9E-07	0,103	-3,0E-06	0,701	-2,1E-06	0,364
Pib			9,0E-07	0,000	9,0E-07	0,000	-1,1E-06	0,854	1,0E-07	0,764
Tempe			-0,070	0,832	-0,083	0,803	4,958	0,826	0,499	0,681
Sole			-0,004	0,000	-0,004	0,000	0,007	0,818	0,002	0,788
Lluvi			-0,003	0,003	-0,003	0,003	-0,010	0,766	-0,004	0,569
Hume			0,166	0,000	0,166	0,000	1,208	0,762	0,428	0,038
Pormuj			-42,500	0,037	-40,042	0,050				
_cons	27,228	0,000	29,110	0,133	23,145	0,232	-138,193	0,827	-12,615	0,744

Source: Own elaboration.

Similar to what happened in Table 6, there are a few parameters that are statistically significant. So, the main conclusion in this cases is that. It would be an indicator of the lack of impact for projects financed with ERDF funds, regardless to the point in time where you take the data.

6. CONCLUSIONS

This paper studies the effect that water projects, financed by EU funds, have had on the efficiency of water distribution in the period 2007-2010. Using data from Spanish municipalities, we performed a descriptive analysis of the evolution from this period. Then, we study the impact that structural EU funds have on the efficiency in water distribution using the diff-in-diff approach. We use different specifications of the panel data model in order to calculate the impact that such projects have had on the variable under study. The results show that these measures have a significant effect in reducing the amount of water supplied per capita, as well as in terms of reducing water leakages, but the impact on the second variable is not as clear as the effect in per capita water distribution for different static panel data models and dynamic panel specifications, we obtain impact estimations of ERDF cofinanced projets on the per capita water distribution. However, the impact is not so clear for the other result variable given by percentage of water registered over the total water distributed.

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