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Navarro Espigares, José Luis; Martín Segura, José Aureliano; Hernández Torres, Elisa
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WATER POLICY AND TOURISM IN SPAIN: A REGIONAL ANALYSIS

José Luis Navarro Espigares - University of Granada - E-mail: jnavarro@ugr.es
University Hospital Virgen de las Nieves - E-mail: josel.navarro.sspa@juntadeandalucia.es
José Aureliano Martín Segura - University of Granada - E-mail: jnavarro@ugr.es
Elisa Hernández Torres - University Hospital Virgen de las Nieves - E-mail: elisa.hernandez.sspa@juntadeandalucia.es

Resumo:

Crescimento económico espanhol levou a um aumento da degradação ambiental, com repercussão negativa na saúde pública. A deterioração é parcialmente refletido no baixo nível de tratamento de águas residuais. Embora a série de dados nacional sobre águas residuais tratadas mostra uma evolução favorável, a comparação por regiões revela a existência de diferenças importantes entre eles. Estas diferenças de crescer como um resultado do aumento das pressões de planejamento urbano, por vezes agravados por um aumento de turistas também.

Este trabalho analisa a relação entre a qualidade da água e do turismo. Os resultados mostram comportamentos muito fraca convergência regional no volume de águas residuais tratadas e de água recuperada. Regiões que recebem mais turistas apresentam um maior volume de águas residuais tratadas, mas não o suficiente para compensar a diferença em termos per capita com outras regiões onde o turismo tem um impacto muito menor. Assim, o impacto ambiental do turismo deve ser tido em conta como fator relevante para a competitividade e as desigualdades na saúde pública.

Palavras-chave: convergência regional, poluição aquática, turismo.

Códigos JEL: Q53, R12, L83

Abstract:

Spanish economic growth has led to an increase in environmental deterioration, with a negative repercussion in public health. The deterioration is partly reflected in the low level of wastewater treatment. While the national data series on treated wastewater shows a favourable evolution, the comparison by regions reveals the existence of important differences among them. These differences grow as a result of the increase of urban planning pressures, sometimes aggravated by an increase in tourists as well.

This work analyses the relationship between water quality and tourism. The results show very weak regional convergence behaviours in the volume of treated wastewater and reclaimed water. Regions receiving more tourists present a greater volume of treated wastewater, but not enough to compensate for the difference in per capita terms with other regions where tourism has a much lower impact. Thus the environmental impact of tourism must be taken into account as a relevant factor for competitiveness and public health inequalities.

Keywords: regional convergence, water pollution, tourism.

JEL Codes: Q53, R12, L83

Introduction

Water is essential for life. Our existence, as well as economic activity, is entirely dependent on this precious resource. Indeed, water resources are affected by many applications such as those in agriculture, industry and domestic consumption.

To address this area of economic and environmental research, in October 2000, the European Parliament and Council adopted the Water Framework Directive, which establishes a framework for Community action in water policy. This was implemented in Spain in 2004. The directive states that by 2015 a good ecological status for all European waters should be achieved. It also includes the principle of "polluter pays" and establishes the appropriate recovery of costs for services related to the water cycle.

In 2002 the Economic and Social Council adopted the General Observation No. 15, dedicated to the right to water, which establishes the criteria for the enjoyment and quantification of basic needs, i.e. the minimum volume of water per person that must be guaranteed in accordance with the following four criteria: adequacy, safety, accessibility and affordability. The right to water and its inclusion in the legal systems of the countries are issues that have been discussed at global forums of The Hague (2000), Kyoto (2003) and the International Conference on Water Resources of Bonn (2001).

From a strategic perspective, water is both a right and a responsibility. It has economic, social and environmental value, so any public or private action must take into account these three dimensions. Water is not an unlimited resource, nor is its availability in adequate quantity and quality free of charge. We have to keep in mind the actual costs and also the economic profit generated from its use, while at the same time guaranteeing a minimum flow to sustain ecosystems.

Contaminated water is a major cause of death among children in developing countries. The UN goal No. 10 of the Millennium Development Goals, adopted in 2002, set itself the target of cutting in half the proportion of people without access to safe drinking water and basic sanitation by 2015. As regards access to drinking water the figures rose from 77% in 1990 to 83% in 2002. Sanitation coverage increased from 49% in 1990 to 58% in 2002. However, this growth remains insufficient to achieve the goal of 75% in 2015.

In Spain, the scarcity of water has obliged the optimisation of re-using treated water for municipal consumption (cleaning of streets and drainage, irrigation of parks and gardens, etc.) and agriculture. The Royal Decree 1620/2007 of the Ministry of the Presidency introduces the term of reclaimed water as water that has undergone a treatment process to adjust its quality to its intended use. In the period 2000-2005 the volume of recycled water increased by 69%. The use of reclaimed water for human consumption is prohibited, except in the case of disaster declarations and only with appropriate health safeguards.

Seawater or brackish water desalination is an option for producing potable water in areas where there are water shortages. In 2006, in Spain there were more than 700 desalination plants with an installed capacity of more than two millions m^3/day. Of these, seawater accounted for 70% while the remaining 30% derived from the brackish waters (aquifers in direct contact with seawater or isolated). The first seawater desalination plant was installed in Lanzarote (Canary Islands) in 1964. Per litre from the sea, desalination is less than half. The resulting brine has a salt content two times higher than seawater, and is usually returned to the sea. In 2004, 1.4 hm^3 /day were desalted, which represented about 400 hm^3 a year.

It should be noted that the term "water use" refers to the volume of water used by a given sector (households, agriculture, industry, etc.) to satisfy basic human or economic necessities, while the term "consumption of water" refers to the volume of water that is not returned to the environment after utilisation.

We can distinguish seven types of use: domestic (feeding, washing, sanitation), public (hospitals, schools, street cleaning, public fountains, irrigation of gardens), use in industry and services, agriculture and livestock, as a primary source of electrical energy, in inland waterway communications, for sport and leisure. In 2005, according to estimates from the various surveys of Spanish National Institute of Statistics of households and economic sectors, the total water utilisation in Spain was 22,200 hm^3.

Water is highly dependent on the tourism industry in sectors of hotels and recreational facilities (spas, golf courses, etc.). The average water use per capita in tourist municipalities is substantially higher than in municipalities where the seasonal population does not vary significantly.

Golf is undoubtedly an emerging water user in the Spanish economy. The water needs of the golf courses in the north of Spain are estimated at 1600 m^3 per hectare, while in the south and on the Mediterranean coast, this indicator is between 10,000 and 13,500 m^3. In absolute terms, the golf courses require 120 hm^3, which is less than 1% of the total water demand.

Some of the major concerns relate to the impacts of water pollution (eutrophication, acidification, toxic contamination) on human health, on the cost of drinking water treatment and on aquatic ecosystems. Despite significant progress in reducing pollution loads from municipal and industrial contamination points through installation of appropriate wastewater treatment plants, improvements in freshwater quality are not always easy to discern, except for organic pollution. Pollution loads from diffuse agricultural sources are an issue in many countries, as is the supply of permanently safe drinking water for the entire population.

The main challenge is to protect and restore all bodies of surface and ground water to ensure the achievement of water quality objectives. This implies further reducing pollution discharges, through appropriate treatment of wastewater and a more systematic integration of water quality considerations in agricultural and other sectoral policies. It also implies an integrated management of water resources based on the ecosystem approach.

Protection of freshwater quality is an important part of Agenda 21, adopted at UNCED (1992) and of the Plan of Implementation adopted at the WSSD in Johannesburg (2002). The main indicator relates to wastewater treatment. It shows the percentage of the national population actually connected to public wastewater treatment plants in 2006. The extent of secondary (biological) and/or tertiary (chemical) treatment provides an indication of efforts to reduce pollution loads.

When interpreting this indicator it should be noted that wastewater treatment is at the centre of countries' financial efforts to abate water pollution. It should be related to an optimal national connection rate taking into account national specificities such as population in remote areas. It should also be read in connection with other indicators of the OECD Core Set, including public wastewater treatment expenditure and the quality of rivers.

The OECD-wide share of the population connected to a municipal wastewater treatment plant rose from nearly 50% in the early 1980s to about 70% today. For the OECD as a whole, almost half of public pollution abatement and control expenditure relates to water (sewage and wastewater treatment). This domain represents up to 1% of GDP in some countries, when considering the private sector.

The share of population connected to wastewater treatment plants and the level of treatment vary significantly among OECD countries: secondary and tertiary treatment has progressed in some, while others are still completing sewage networks or the installation of first generation treatment plants. Some countries have reached the economic limit in terms of sewage connection and use other ways of treating wastewater from small, isolated settlements.

Tourism has an extraordinary importance for Spanish economy. In the Travel & Tourism Competitiveness Report 2009, Spain is ranked just behind France within Europe, at 6th place overall. Spain is ranked 1st out of all countries for the richness of its cultural resources, with many World Heritage sites, a large number of international fairs and exhibitions, and significant sports stadium capacity.

Spain's tourism infrastructure is ranked 1st internationally, with many hotel rooms, car rental facilities, and automatic teller machines (ATMs); its air transport infrastructure also gets good marks (ranked 10th). The government prioritises the sector significantly, and the country makes strong efforts to attract tourists through strong destination-marketing campaigns and by ensuring Spain's presence at many international tourism fairs.

For many years, tourist industries have been crucial to Spain's economy, an importance that has increased over recent years. It is important to note that the build-up of the country's accommodation infrastructure has in some regions come at the expense of creating overcrowded tourist locations and damaging the quality of the environment.

In fact, with regard to environmental sustainability, Spain demonstrates a more nuanced performance (ranked 31st in this environment pillar). On the one hand, the government is making a statement of its commitment to environmental protection by ratifying the great majority of the most important environmental treaties (ranked 2nd). However, the actual stringency and enforcement of the country's environmental regulation is not as evident, ranking 36th and 37th, respectively. And indeed, in terms of environmental indicators, the rankings are low: the percentage of threatened species is ranked 96th and carbon dioxide emissions are ranked 94th. Overall, Spain should consider enhancing its environmental performance in order to ensure that the growth of its Travel & Tourism (T&T) sector takes place in a sustainable manner, thus enabling the country to reap the long-term benefits of its development.

To summarise, Spain provides many examples of T&T best practices. The country's *Plan de Turismo 2020* clearly aims to address many of the challenges identified by the Travel & Tourism Competitiveness Index (TTCI), notably the creation of friendlier policies for the sector and a stronger focus on environmental sustainability. Making these improvements will be critical for Spain in ensuring continued T&T competitiveness in the future, in the context of ever-increasing competition among destinations.

The paper is organised as follows. In the next section we will investigate whether the improvement in the wastewater treatment observed in the Spanish national data has been homogeneous, or if there has been variability among the Spanish Autonomous Communities. The association of the volume of treated wastewater with the recent evolution in building construction will also be analysed.

With the data on wastewater treatment and the variable of building construction, a panel data was prepared by regions and by years. The panel collected information for 18 regions during 1996-2006, and, by means of statistical analysis of covariance, we studied the existing variability in the treatment of wastewater among different regions and years. In addition, by applying an econometric panel data model with fixed effects, the dependency of the two variables was evaluated.

Then this paper analyses the evolution of the observed regional differences. Seven variables related to water quality have been studied: treated wastewater, treated wastewater disposal, reclaimed wastewater, water supplies, household water supplies, water supplies for other uses, and the percentage of water lost in distribution. The Spanish National Institute of Statistics is the data source and the time period covered is 1999-2006. Besides the descriptive analysis of the variables, we apply the concepts of beta and sigma convergence, which both derive from the economic literature related to economic growth.

In the last section we study the relationship among environmental variables concerning water and those related to tourism. The results obtained from the models indicate that the association between tourism intensity and water use is not statistically significant in any case, and despite the aforementioned convergence, there are also substantial differences among regions, with regard to management of water resources, which is independent of tourism intensity.

Finally, we conclude that the tourism phenomenon does not exert a decisive influence on how water resources are managed.

Wastewater Treatment Heterogeneity

The main objective of the OECD program for the analysis of environmental performance is to assist member countries in improving the results obtained in individual and collective management of the environment with respect to their internal goals and international commitments. In 2004, the OECD environmental report for Spain stated that during the period 1980-2000 Spain had achieved the dissociation of freshwater extraction and economic growth. Freshwater extraction fell 3%, while the GDP grew 7%. However, the OECD also acknowledged that economic growth had led to increasing pressures on the environment, in pollution and in the use of natural resources such as water or soil as well.

The OECD study specifically mentioned that the increase in international tourist arrivals by 52%, the construction at a rate of 700,000 new housing per year, and the population density in coastal regions and islands (where 60% of the population lives) were part of the problem. These factors resulted in difficulties such as high water usage, consumption inequality among communities, or low level of wastewater treatment, which had worsened as a result of overexploitation of coastal land and the lack of purification resources. Specifically, the report anticipated that Spain could not meet the EU Directive on the treatment of wastewater in 2000. And it predicted that only a few Communities like Madrid and Navarra would be able to meet the standards in 2005. It also highlighted some major cities such as Barcelona, Coruña, Cádiz or San Sebastian that lacked adequate systems for water purification.

In 2008 the updated report noted that in Spain there were more than 2,500 sewage treatment plants that purified more than 3375 hm^3 of which 13% are reused annually. At the same time it explained that the National Plan in accordance with the Water Framework Directive seeks to achieve the objective of good ecological water status by 2015. Thus, the OECD report confirms that since water is a limited resource, wastewater treatment is crucial in terms of its impact on the environment and human health.

To examine the regional variability of the treated wastewater a fixed effects experiment with two factors (regions and years) and one covariate (total built area) was designed. Data on wastewater treatment were obtained from the National Institute of Statistics[1] (Table 1). The volume of treated wastewater serves as the dependent variable. Statistical factors of this experiment have been divided into two levels, one for regions and another for years. Additionally, we have considered the existence of blocs coinciding with the periods of the statistical series. Our objective is to determine whether the improvement in the treatment of wastewater that is observed in the national series is homogeneous for all regions and periods, or if, on the contrary, there has been variability in the amount of treated wastewater among regions and years.

The results of statistical F tests show that both the regional and time factors significantly influence the observed variability of the wastewater treatment (Table 2).

The influence of the variable "building construction" was also verified. The panel data model of fixed effects confirmed that the wastewater treatment was 70% explained by the regression and that the "building construction" exerted a significant and negative influence on wastewater treatment, although with a coefficient near one.

The error term in panel data models has several components; some are time-invariant and others are invariant with respect of units. Because of this diversity the assumption of normality for distribution of residuals is not usually fulfilled in these models. In our model we applied the normality test using

TABLE 1

Treated Wastewater by Region

Treated wastewater by region (m^3 / inhabitant / day)											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
NATIONAL	**0.133**	**0.149**	**0.166**	**0.180**	**0.191**	**0.190**	**0.192**	**0.199**	**0.377**	**0.331**	**0.307**
Andalucía	0.165	0.173	0.184	0.198	0.208	0.215	0.206	0.216	0.26	0.222	0.222
Aragón	0.127	0.131	0.153	0.167	0.217	0.206	0.203	0.237	0.458	0.457	0.433
Asturias (Principado de)	0.092	0.097	0.098	0.103	0.107	0.088	0.080	0.133	0.249	0.275	0.304
Balears (Illes)	0.221	0.222	0.231	0.230	0.217	0.175	0.188	0.189	0.348	0.461	0.367
Canarias	0.088	0.089	0.088	0.089	0.106	0.098	0.113	0.119	0.109	0.132	0.149
Cantabria	0.072	0.112	0.115	0.126	0.162	0.092	0.121	0.155	0.369	0.511	0.499
Castilla-León	0.134	0.136	0.147	0.160	0.121	0.120	0.207	0.216	0.394	0.579	0.630
Castilla-La Mancha	0.082	0.086	0.107	0.109	0.161	0.191	0.169	0.187	0.260	0.307	0.253
Cataluña	0.242	0.288	0.302	0.308	0.291	0.254	0.220	0.215	0.288	0.230	0.279
Comunitat Valenciana	0.069	0.078	0.093	0.100	0.155	0.133	0.145	0.162	0.551	0.405	0.278
Extremadura	..	0.055	0.061	0.065	0.140	0.166	0.227	0.248	0.117	0.329	0.260
Galicia	..	..	0.122	0.140	0.137	0.166	0.191	0.181	0.415	0.269	0.245
Madrid (Comunidad de)	0.188	0.198	0.203	0.211	0.217	0.211	0.200	0.198	0.634	0.393	0.368
Murcia (Región de)	0.063	0.064	0.065	0.071	0.073	0.173	0.181	0.190	0.225	0.254	0.214
Navarra (Comunidad Foral de)	..	..	..	0.230	0.244	0.219	0.247	0.260	0.564	0.567	0.579
País Vasco	0.175	0.184	0.193	0.199	0.201	0.208	0.226	0.244	0.427	0.490	0.308
La Rioja	..	..	..	0.182	0.199	0.256	0.298	0.195	0.968	0.893	0.801
Ceuta and Melilla	..	..	..	0.131	0.134	0.144	0.138	0.133	0.201	0.170	0.135

Source: Instituto Nacional de Estadística (INE) de España

[1] http://www.ine.es/jaxi/tabla.do?path=/t26/p069/p03/l0/&file=01002.px&type=pcaxis&L=0

TABLE 2

Inter-Subject Variability Test

Dependent variable: treated wastewater

Source	Sum of squares Type III	Degrees of freedom	Mean Square	F	Significance
Corrected Model	2.870(a)	28	.102	14.301	.000
Intersection	1.537	1	1.537	214.540	.000
Regions	1.117	17	.066	9.171	.000
Built area	.073	1	.073	10.144	.002
Year	1.511	10	.151	21.082	.000
Error	1.082	151	.007		
Total	13.236	180			
Corrected total	3.952	179			

(a): R^2=0.726 (corrected R^2=0.675)

the Jarque-Bera statistic and the null hypothesis of normality of the residuals was rejected. However, graphical distribution of residuals draws a curve very similar to normal. Thus, this problem has been solved by applying a fixed effects model in time and units.

Similarly it was found that the homoskedasticity assumption between transverse and temporal units was not met. To overcome this circumstance a correction of the variance-covariance matrix that becomes it consistent with the presence of heteroscedasticity was carried out. The results obtained after this correction were similar to those obtained in the original model.

Regional Convergence on Water Quality

Numerous investigations have shown that water quality affects public health. Therefore, the quality of water should be the same in all territories of a country. In the previous section statistically significant differences in Spain were verified regarding some variables that determine water quality. Regional differences of these variables could be regarded as a source of divergence in population health.

In this section we analyse the evolution of the observed regional differences. Seven variables related to water quality have been studied: treated wastewater, treated wastewater disposal, reclaimed wastewater, water supplies, household water supplies, water supplies for other uses, and the percentage of water lost in distribution. The Spanish National Institute of Statistics is the source of data and the time period covered is 1999-2006. Besides the descriptive analysis of the variables, we apply the concepts of beta and sigma convergence, both of which derive from the economic literature related to economic growth.

Barro and Sala-i-Martin (1995) and Sala-i-Martin (1996) draw a useful distinction between two types of convergence in growth empirics: σ-convergence and β-convergence. When the dispersion of real per capita income across a group of economies falls over time, there is **σ-convergence**. When the partial correlation between growth in income over time and its initial level is negative, there is **β-convergence**.

Sala-i-Martin (1996) makes a distinction between conditional β-convergence (as described above) and absolute β-convergence, where poor economies simply grow faster than wealthy ones. For simplicity, and since absolute β-convergence can be a specific case of conditional β-convergence where balanced growth paths are identical across economies, we focus on the conditional concept and call it β-convergence.

β-convergence is not a sufficient condition for σ-convergence. Quah (1993) and Friedman (1992) both suggest that σ-convergence should be of interest since it speak directly to whether the distribution of income across economies is becoming more equitable. Still, β-convergence remains a primary focus of growth empirics, perhaps because, intuitively, it seems to be necessary for σ-convergence.

Variation of value for the i^{th} region can be approximated by:

$$\left[\frac{1}{T}\right]\left(w_{i,t} - w_{i,t+T}\right) = a + bw_{i,t} + \varepsilon_{i,t}$$

Where T is the whole studied period; w is the variable that represents the water treated in each region i; $w_{i,t}$ is the initial quantity of treated water; $w_{i,t+T}$ is the final quantity of treated water; a and b are the parameters to be estimated, and $\varepsilon_{i,t}$ the error term.

A negative and statistically significant value of $\hat{b}$ implies the existence of β-convergence and vice versa. In addition, a logarithmic transformation of the independent variable becomes its estimator in a measurement of the convergence speed independent of the scale. The coefficient of determination, R^2, provides a measure of how well future outcomes are likely to be predicted by the model, i.e. R^2 will give us information about the goodness of fit of the model.

The model to be estimated follows the non linear classic specification (Sala i Martín, 1996):

$$\left(\frac{1}{T}\right) ln\left(\frac{w_{i,t+T}}{w_{i,t}}\right) = a - \left(\frac{1 - e^{-\beta T}}{T}\right)\ln\left(w_{i,t}\right) + \varepsilon_{i,t}$$

where β is the speed of convergence (0 < β < 1), which can be also obtained by means of this transformation:

$$-\beta = (1 / T)[\ln (1 - Tb)]$$

Thus, β > 0 implies a negative correlation between variation and initial log value of the studied variable.

The Table 3 reflects the results of β-convergence for the studied variables (full data and graphics can be seen at Annex I).

All variables present a convergent behavior according to the beta-convergence criterion, i.e. in all cases the sign of the parameter b is negative and the beta value is between 0 and 1. However, in some cases the correlation between the initial values of the variables and their rate of change in the period studied is very weak (treated wastewater, water reuse, water supply to households, and losses in the distribution). Fit functions are statistically significant in three of the seven variables tested (discharged water, water supplies, water supply for other uses).

As we said before, beta-convergence is not a sufficient condition for sigma-convergence. In this case, although beta-convergence is observed in all analysed variables, dispersion diminution of regional values occurs in only 4 variables (water discharge, water supplies, water supply for other uses, and losses in the distribution).

TABLE 3

Beta Convergence

Independent variable	Treated wastewater	Wastewater disposal	Reclaimed wastewater	Water supplies	Household water supplies	Water supplies for other uses	Water lost in distribution (%)
T	7	6	7	7	7	7	7
R Squared	0.2250	0.5874	0.2535	0.7070	0.3540	0.7519	0.4289
b	-0.0764	-0.1478	-0.0715	-0.1177	-0.1014	-0.1111	-0.0986
F	4.6450	22.7819	5.4337	38.6059	8.7682	48.4962	12.0170
Significance	0.0467	0.0002	0.0332	0.0000	0.0092	0.0000	0.0032
Beta	0.0612	0.1058	0.0580	0.0859	0.0766	0.0822	0.0750

As graphical illustrations for the analysis of convergence, graphs corresponding to the first variable analysed, treated wastewater, are shown below.

In Figure 1, the X-axis represents the initial value of the variable in 1999 and the Y-axis the variation rate during the studied period (1999-2006). We have included two lines that mark the average values for both axes. These lines allow us to distinguish four quadrants in which the regions are grouped according to their convergence (quadrants II and IV) or divergence (quadrants I and III). Finally, the negative slope of the linear function adjusted shows us the existence of the β-convergence, although in this case the value of R^2 is very low, reflecting the large distance between the actual values and those estimated by the model.

The σ-convergence graph convergence graph (Figure 2) shows the evolution of the dispersion among the logarithms of regional values. In this case the dispersion at the end of the period is higher than the original, symptomatic of a divergent evolution of the variable. However, we note the existence of a methodological change in 2004 that involves a breakdown of the trends. This same phenomenon is observed in the variables related to the disposal and the reuse of water.

The results show that all variables demonstrate beta-convergence. However, the methodological change that occurred in 2004 made it impossible for the reduction in the dispersion over time for all variables

FIGURE 1

Beta Convergence: Treated Wastewater

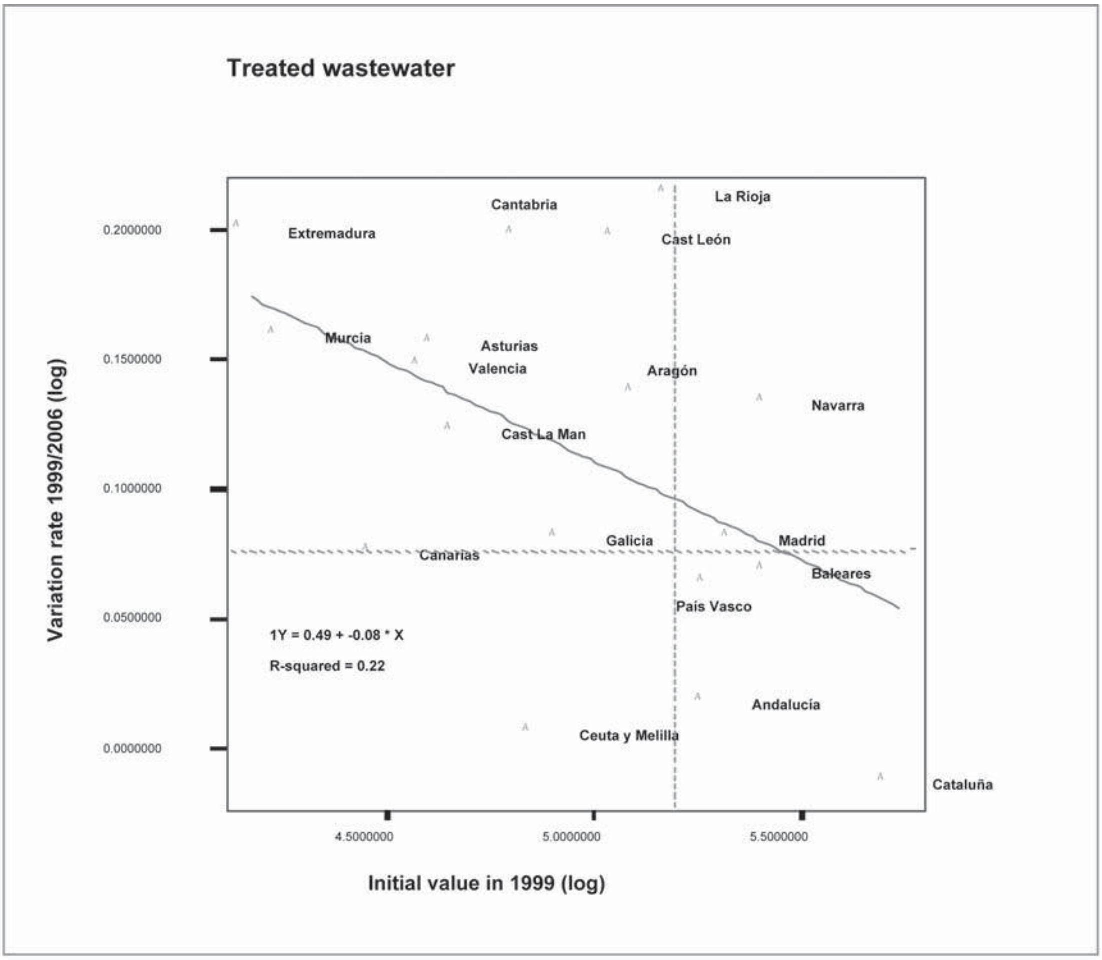
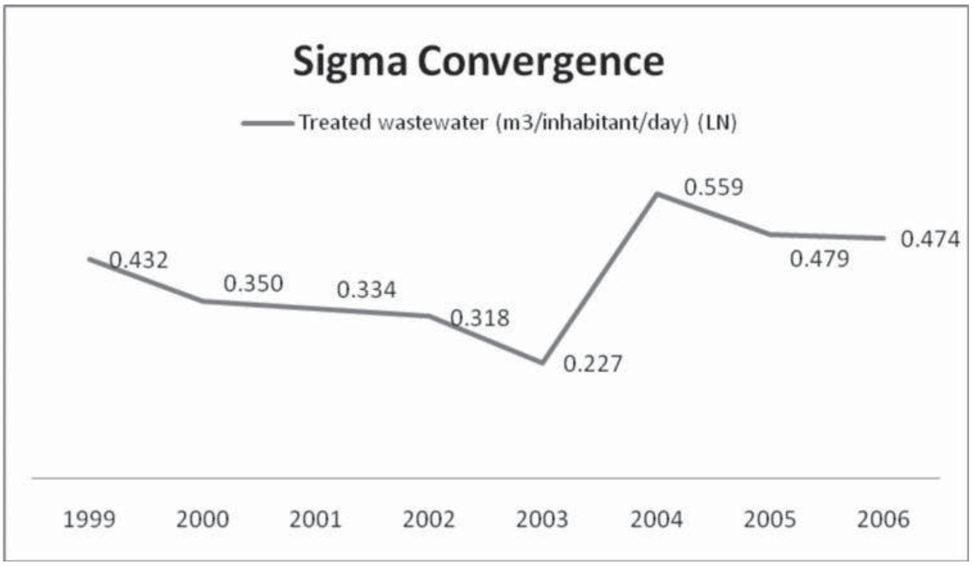


FIGURE 2

Sigma Convergence: Treated Wastewater



to be verified. In particular we observed very weak convergence in the volume of treated wastewater and reclaimed water. Stronger convergence appears in the volume of water supply, especially in the case of supply for other uses.

Despite the improvement at the national level and the β-convergence, there are also substantial differences among regions. Consequently, further development is needed in consolidating the process of reducing regional disparities in water quality as a complementary way of reducing inequalities in health.

Tourism and Water Quality

In this final section of the work, we verify the relationship between water quality and tourism from a regional perspective. Tourism in Spain's regions will be analysed through the following variables: domestic travellers, foreign travellers, total travellers received, overnight stays by residents, overnight stays of foreigners, and total overnight stays (Table 4). The variables relating to water consumption and quality will be the same as those used in the section above for the analysis of convergence: treated wastewater, treated wastewater disposal, reclaimed wastewater, water supplies, household water supplies, water supplies for other uses, and the percentage of water lost in distribution. The source of statistical information is still the National Institute of Statistics and data refer to 2006.

First we analysed the relationship between tourism variables and each of the variables related to water. We used a linear regression model in which variables related to water acted as dependent variables and tourist variables as independent or explanatory variables (Table 5).

The results allowed us to conclude that the environmental aspects related to water in the Spanish regions are not related to the tourism phenomenon. None of the models is significant as a whole. Moreover, in all models, R^2 is very low except in the last instance. Nevertheless, in this model, none of the independent variables has a statistically significant explanatory power for predicting the behaviour of the reused wastewater.

Once the lack of association between tourist variables and variables related to the use and quality of water had been verified, it is surprising that a relationship mentioned in most of the tourist and environmental reports did not appear. In the introductory paragraph we cited the OECD report on environmental indicators and the report on the competitiveness of the tourism sector, both of which

TABLE 4

Tourism in Spanish Regions

	Travellers			Nights Spent		
REGIONS	Total	Spanish	Foreigners	Total	Spanish	Foreigners
TOTAL	81,855,902	47,444,140	34,411,762	267,027,859	115,088,253	151,939,606
Andalucía	15,608,612	9,652,603	5,956,009	43,809,767	24,198,435	19,611,332
Aragón	2,121,294	1,806,873	314,421	4,405,041	3,780,644	624,397
Asturias (Principado de)	1,523,045	1,363,685	159,36	3,275,773	2,930,973	344,8
Balears (Illes)	8,359,870	1,692,072	6,667,798	52,056,787	7,411,575	44,645,212
Canarias	6,810,235	2,349,753	4,460,482	47,172,391	9,964,042	37,208,349
Cantabria	1,180,505	1,009,305	171,2	2,800,813	2,436,900	363,913
Castilla y León	4,249,103	3,508,703	740,4	7,194,273	6,032,525	1,161,748
Castilla-La Mancha	2,084,183	1,780,012	304,171	3,618,421	3,102,215	516,206
Cataluña	14,252,876	6,312,831	7,940,045	42,076,031	15,062,797	27,013,234
Comunitat Valenciana	7,653,348	5,248,696	2,404,652	25,052,420	15,418,995	9,633,425
Extremadura	1,113,056	975,841	137,215	2,015,231	1,798,326	216,905
Galicia	3,599,220	2,944,778	654,442	7,758,045	6,524,667	1,233,378
Madrid (Comunidad de)	8,645,574	5,226,370	3,419,204	16,498,311	9,201,885	7,296,426
Murcia (Región de)	1,168,488	950,461	218,027	2,707,630	2,225,775	481,855
Navarra (Comunidad Foral de)	751,987	605,144	146,843	1,444,906	1,198,405	246,501
País Vasco	2,090,907	1,474,889	616,018	3,932,308	2,753,957	1,178,351
Rioja (La)	524,687	449,864	74,823	943,056	820,703	122,353
Ceuta y Melilla	118,906	108,399	81,434	196,922	177,687	90,162
Melilla	47,979	37,472	10,507	125,995	106,76	19,235

TABLE 5

Regression Models

Independent variables:
National travellers
Foreigner travellers
Nights spent by national travellers
Nights spent by foreigner travellers

Dependent variable	**R2**	**F**	**Significance**
Water supplies	0.073	0.255	0.901
Treated wastewater	0.151	0.578	0.684
Water losses in water distribution	0.168	0.656	0.633
Reclaimed wastewater	0.612	5.127	0.011

pointed out the relationship between tourism activities and environmental deterioration, also noting the particular intensity with respect to the loss of water quality.

To retrieve the statistical association, we introduced a statistical variable mentioned in the first section when we analysed regional diversity, the *total built area*. The influence of this variable was observed when analysing the regional heterogeneity in treated wastewater.

In particular, we relate the dependent variable *total built area* and the independent one *total number of travellers*, by means of a linear regression model. The explanatory power of the independent variable was found to be high (R^2=0.709); the association is positive (b=0.001) and the model is statistically significant (F=39.054, p-value=0.000). Therefore, we can ensure that those regions that have received a greater number of travellers have a greater *total built area* as well.

Presumably a larger surface area will require a greater volume of water supplied. As above, we used a linear regression model to relate the dependent variable, *total water supply (m3)*, with the independent one, *total number of travellers*. This association is also positive and statistically significant (R^2=0.911; b=65045.89; F=162,947; p-value=0.000).

If a greater number of visitors generated an increase in construction, and this requires greater volumes of water supplied, it can be assumed that volumes of treated wastewater increased. Indeed, the relationship between the variables *total number of travellers* and volume of *treated wastewater* is positive and statistically significant (R^2=0.635; b=65,702; F=27,856; p-value=0.000).

All these positive relationships verify that when the number of travellers increased in a region the total built area also grew, as did the volume of water supplied and the volume of treated wastewater. However, when variables related to utilisation and supply of water are expressed in per capita terms these associations are not found. This means that the regions receiving more tourists indeed present a greater volume of treated wastewater, but not enough to compensate for the difference in per capita terms with other regions where tourism has a much lower impact.

Conclusions

We will present the conclusions based on the results of the analysis offered in the three blocks of the preceding headings. First, it is necessary to highlight the extraordinary regional diversity in water-related variables. In accordance with the coefficient of variation (CV = σ/x) of these variables in 2006, greater variability was found in the volume per person and day of reclaimed water (1.51), water disposal (0.60) and treated wastewater (0.57). Variables related to the volume of water supply are those with a lower variability (0.13). Furthermore, analysis of covariance performed has ratified the statistical significance of the variability with reference to the regions and years.

The second block of content has allowed us to conclude that despite the improvement observed in the national series of treated wastewater, the reduction of regional disparities was very weak during the ten years studied. It should be remembered that the methodological changes introduced in 2004 has truncated the reduction of dispersion in the variables: treated wastewater, water disposal, and reclaimed water. The variable that provides a clear converging trend is the volume of water supplied per person and day.

Given its influence on the health conditions of the population, it is remarkable to notice the high contrast of values observed in the quantities of treated wastewater among Autonomous Communities. The maximum values in 2006 are found in some regions of northern Spain where tourism is not very pronounced such as La Rioja (0.801 m^3) and Navarra (0.579 m^3), while the minimum ones are located only in some areas where tourism offers a high intensity such as the Canary Islands (0.149 m^3) and Andalusia (0.222 m^3).

Finally, the integration of tourism with the facts presented thus far leads us to link the intensity of the tourism sector with the environmental impact resulting from the overuse of water resources. Again we focus our interest on the degree of association between tourism and the volume of treated wastewater.

Tourism in Spain (total number of travellers) is very concentrated in six regions (Andalusia, Catalonia, Madrid, Baleares, Valencia and Canarias). Considering the number of overnight stays, regions that lead the national ranking remained those six, but changed in the position occupied by each. In 1999 four of these regions offered a position higher than the national average, yet, in 2006, only Madrid and Baleares were above the national average. Catalonia in 1999 headed the list at the national level, but in the last ten years it showed lower rates of variation. In the β-convergence graph we can see that among the six tourist regions, three (Madrid, Balearic Islands and Valencia) are located in close proximity to the adjusted linear function, while the other three (Catalonia, Andalusia and Canary Islands) appear far removed from the average behaviour in terms of convergence. So these three regions experienced much smaller increases than would have been expected according to their initial levels.

One possible limitation of this work is its regional approach. Since some of the main tourist areas are extensive territories with a large number of provinces and a high volume of people, they can offer, in turn, heterogeneous behaviour. Therefore, analysis at the provincial level will be subject to future revisions.

As a final conclusion we draw attention to the high degree of commonality of the results obtained in our work with the recommendations of the World Economic Forum (2009) regarding the future of the tourism sector in Spain. In the last section of this paper we have shown that the current effort in the regions with the highest tourism intensity is not sufficient to maintain certain environmental standards in per capita terms. As was said in the Spanish Plan for Tourism 2020, the tourism policy in Spain should consider environmental sustainability in all its extremes. This requirement is not only a necessary condition for maintaining long-term competitiveness of the sector, but at the same time it is needed to reduce health inequities at the national level.

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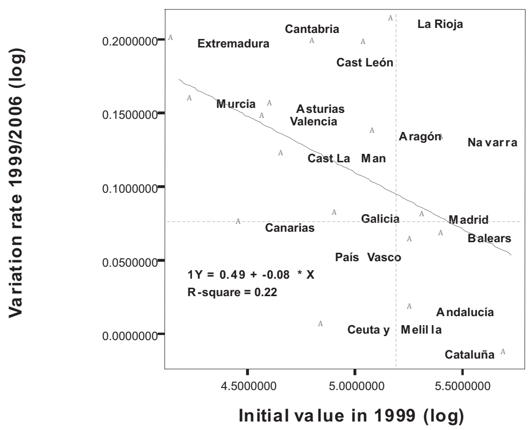
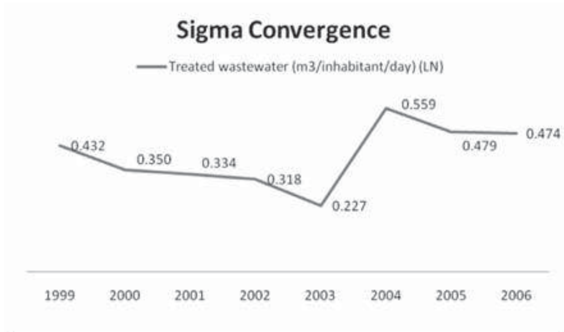
ANNEX 1

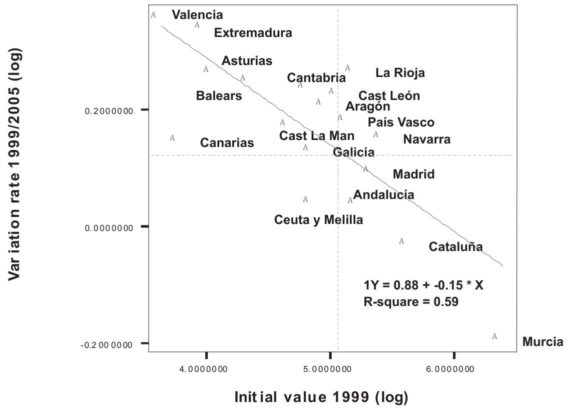
Treated wastewater

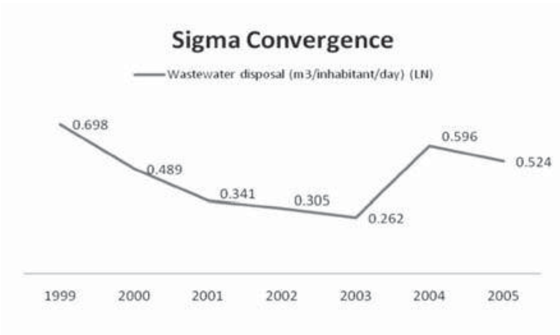




Model Summary	T	R2	b	F	Sign	Beta
	7	0.22	-0.07644	4.645014	0.046719	0.061225

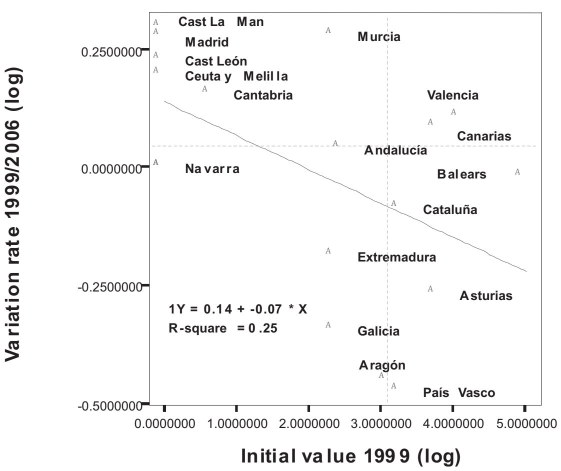
Wastewater Disposal

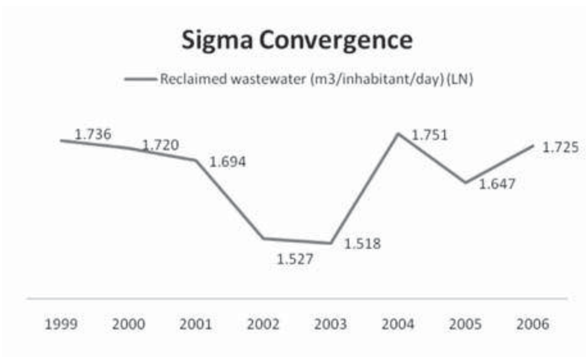




Model Summary	T	R2	b	F	Sign	Beta
	6	0,59	-0,1478	22,78194	0,000207	0,105815

Reclaimed wastewater

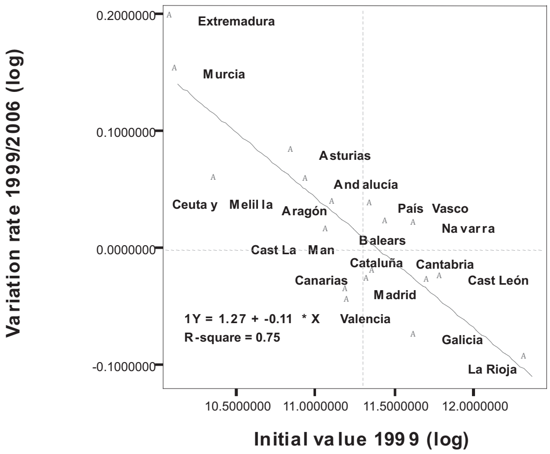


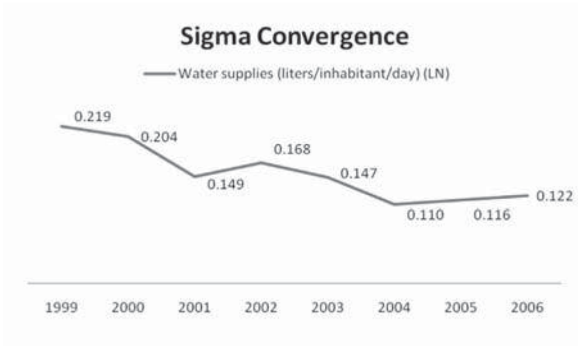


Model Summary	T	R2	b	F	Sign	Beta
	7	0.25	-0.07153	5.433714	0.033155	0.05799

ANNEX 1 (CONT.)

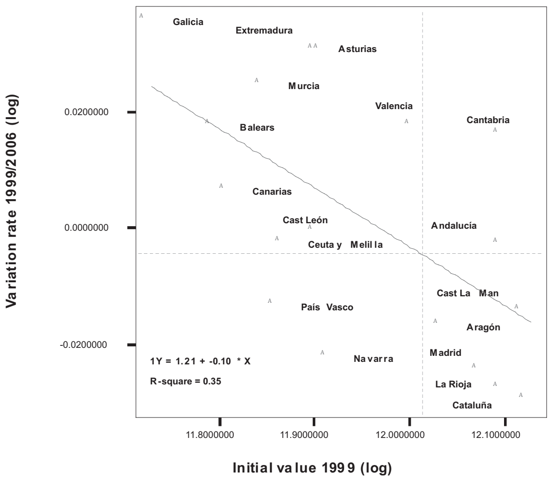
Water Supplies

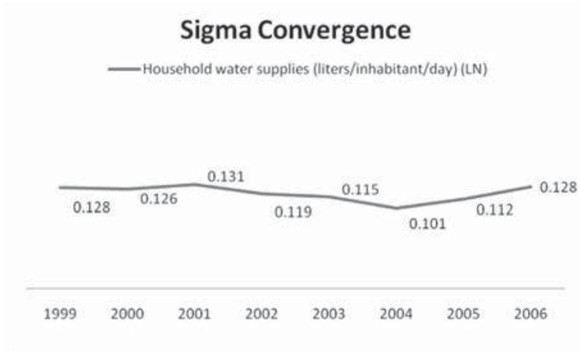




Model Summary	T	R2	b	F	Sign	Beta
	7	0.71	-0.11774	38.60594	1.24E-05	0.085876

Household Water Supplies

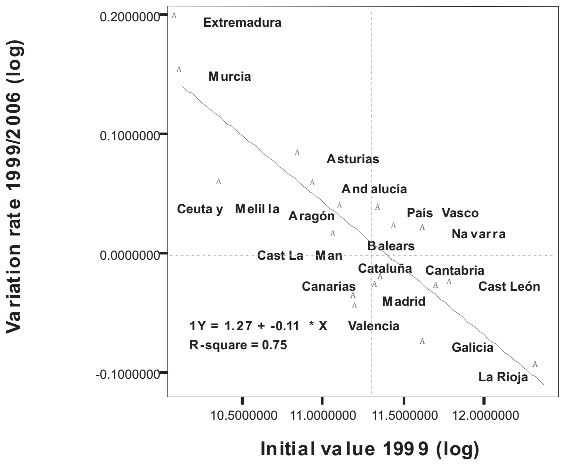


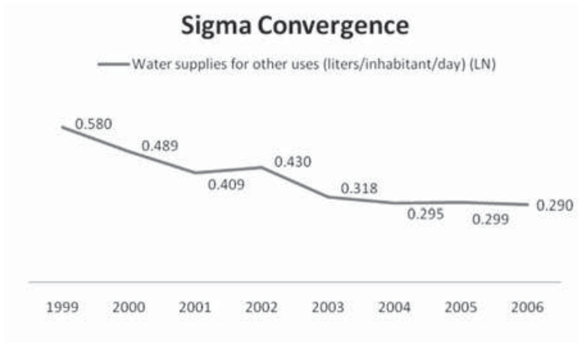


Model Summary	T	R2	b	F	Sign	Beta
	7	0.35	-0.1014	8.76824	0.009195	0.076625

ANNEX 1 (CONT.)

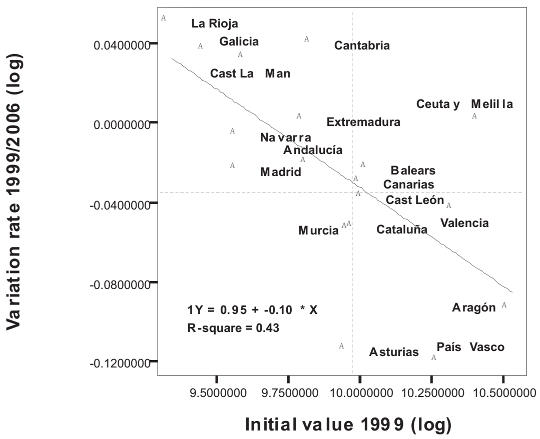
Water Supplies for other Uses

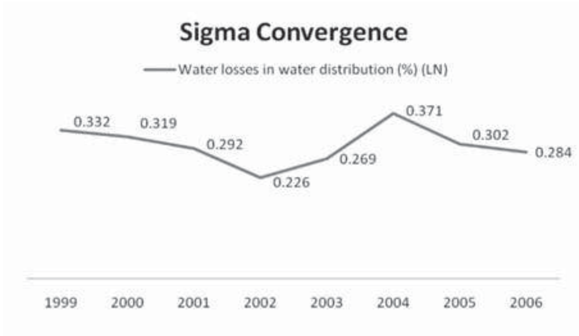




Model Summary	T	R2	b	F	Sign	Beta
	7	0.75	-0.11113	48.49625	3.19E-06	0.082207

Water Losses in Water Distribution (%)





Model Summary	T	R2	b	F	Sign	Beta
	7	0.43	-0.09861	12.01698	0.00318	0.074983