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DO THE REFORMS CONTRIBUTE TO SOCIAL PROGRESS? THE CASE OF WATER SUPPLY AND SEWERAGE SYSTEMS AND CHILD MORTALITY IN COLOMBIA 1990-2004

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BOGOTÁ, JANUARY 2008

TABLE OF CONTENTS

1. INTRODUCTION

The proper provision of water and sewerage services is necessary to overcome poverty issues in developing countries, as well as to improve the population quality of life. Specifically, having access to water and basic sanitation facilities is related to the prevention of gastrointestinal diseases in children and adults[1]. The World Health Organization estimates that 1.8 million people die every year from diseases related to an inadequate provision of water and sanitation; 90% are children under 5[2]. One of the commitments acquired by Colombia in the scope of the Millennium Summit 2000 is to decrease child mortality in children under 5, from 37.4 to 17 deaths per 1000 live birth. Moreover, basic sanitation is one of the components of the sustainability objective, in this case, the planned goal being reducing by half the number of people lacking access to water and sewerage services in the country. This implies bringing water service to 7.7 million people, and sewerage service to 9.2 million people only within the urban area. Both goals were set up using as base line the situation in 1990, and the deadline for meeting this goal is 2015.[3]

By the late 1980's, Colombia begun a reform process within the water and sanitation area that reached its peak with the enactment of Act 142 of 1994, Regime of Household Public Utilities, in which a new institutional order for the provision of services is established, opening the possibility for the participation of private capital in the sector. One of the milestones of the Act was the inclusion of specialized companies in the provision of water and sewerage services with the purpose of expanding the coverage and improving the service quality. Within this scope, the provision by the local government entities was considered an exception within the new targeted institutional order. This exception, however, has been actually the reality for that sector up to now, as the specialized providers have only entered to operate in municipalities with more than 20,0000 subscribers[4].

[1] Esrey, S., Potash, J., Roberts, L. y Shiff, C, (1991).
[2] OMS, (2004).
[3] DNP, (2005).
[4] Roda, (2004).

After more than ten years of the implementation of the reforms, the evaluation of their results emerges as a priority with the objective of identifying the policy guidelines that allow the goals established at the Millennium Summit to be met. This paper is intended to approach an empiric evaluation of the consequences the reforms to the provision of water supply and sewerage services have caused on Colombian population quality of life. Specifically, it is proposed to estimate the impact of the reforms on child mortality from 1990 to 2004.

This paper consists of eight sections, including the introduction. In section 2, a short review of the literature on reforms implemented in the drinking water sector in different countries is presented. In section 3, the reform process implemented in Colombia is described, with special focus on the business transformation set forth by Law 142 of 1994, which regulates the constitutional mandate of promoting business development and allows the provision of Public Utilities Services by private parties[5]. In Section 4, descriptive statistics of data about coverage and child mortality used for this paper are presented. In section 5 and 6, methodology used for the estimation of reform impact on child mortality is developed, and the results obtained are presented. Section 7 comprises the analysis of the effect of the reform on the coverage of the mentioned services, and its relation to the results on child mortality. Finally, in section 8 conclusions drawn from this analytical paper are summarized.

2. LITERATURE ON REFORMS ABOUT THE PROVISION OF WATER AND SANITATION: INCONCLUSIVE EVIDENCE

The relation between drinking water and sanitation availability, and the population quality of life has been widely acknowledged in the related literature (Esrey et al, 1991, Lavy, Strauss, Thomas and Vreyer 1996, Abou Ali, 2002, Jalan and Ravallion, 2003, Fajardo, 2004). Specifically, the lack of water supply and sewerage systems is related to incidence of infectious and transmissible diseases, including diarrhea and cholera, among

[5] Political Constitution of Colombia, Articles 333 and 365.

others, to which child population is specially vulnerable. There are other issues, however, that may explain the onset and duration of these diseases in children, such as proper medical care and hygienic practices, and the education level of parents. (Payment and Hunter, 2001). Many studies have isolated those factors when estimating the effect of the availability of water supply and sewerage services on child mortality. In general, results show that access to these services reduce the child mortality rate by 5% to 27%, disease incidence by about 20% (Galdo and Briceño, 2005[6]), and disease duration by 29% (Jalan and Ravallion, 2003).

The provision of water supply and sewerage services is provided by different institutional areas that affect the scope of coverage and quality; as a result, a relation between the institutional infrastructure of providers (public, private, mixed providers), and population quality of life can be established. This paper analyzes this relation for Colombian case, based on the implemented reforms in the provision of the aforementioned services since early 1990's, and its effect on service coverage and child mortality rate.

Since late 1980's, a process of reforms on the provision of public utility services, water and sanitation, electric power, and telecommunications was initiated in many developing countries. One of the cornerstones of the reforms was the promotion of private providers involvement in the provision of said services, allowing diverse private participation models.

As described below, after almost 20 years since the implementation of the reform, there are many authors that have evaluated its results by means of different approaches and methodologies. In the electric power and telecommunications cases, there is a general agreement on the positive effect private participation has had on both sectors, considering their competitive potential. In the case of water and sanitation, however, the involvement of the private sector is controversial nowadays, as the evaluation of the reforms has not shown conclusive results regarding the positive effects of private involvement in the provision of these services.

[6] This figures correspond to results found by Galdo and Briceño (2005), in a literature review of many studies developed in different countries.

Arguments regarding the advantages resulting from the involvement of the private sector as provider of water and sewerage services can be summarized by the idea presented by De Allessi (1980), which states that the possibility to transfer equity constitutes an incentive for efficiency improvement under the private provision of services. This is consistent with one of the motivations pointed out by promoters of private involvement in water and sanitation sectors, that is to say, low level of efficiency and quality delivered by public sector providers before reform implementation.

On the other hand, opponents to reforms, however, claim that water and sanitation services are public goods, because of the environment and health externalities they generate. Under this premise, it is not possible to reach a socially efficient level of service provision by the private sector, due to the difficulty to internalize or to regulate those externalities efficiently (Noll, Shirley and Cowan, 2000).

Moreover, the following limiting factors to private provision of water supply and sewerage services are identified: natural monopoly nature of the industry, low elasticity of demand, and commercial high risk within lower-income sectors. The reform implemented in Colombia performs between the two extreme points described herein, as the reforms points out the government responsibility to ensure provision of efficient services, and at the same time, it promotes private involvement in the sector, and demands performance and results supervision regardless the kind of provider providing the service.

Besides the argument regarding its convenience, private involvement in the provision of water and sanitation services was implemented in 140 countries from 1990 to 2003 (Prasad, 2006). The reforms consider the different models for the participation of private capital within the sector, such as sales of equity of State-owned companies, concession contracts, and Build, Operate, Manage, Transfer Contracts (BOMT).

According to Prasad (2006), literature on the implementation of reforms within water and sanitation sectors has been focused on the performance of provider companies from the

microeconomic point of view, analyzing efficiency and productivity indicators, but those results are not conclusive regarding the effects private capital involvement have caused. However, the impact of these indicators on the population quality of life and on the decrease of poverty levels have not been studied in-depth.

The hypothesis of transfer of equity stated by De Allesi in 1980 has been refuted empirically in studies carried out in many countries that involved private capital within the water and sanitation sectors, as described below. Until late 1990's, those studies focused on the USA and United Kingdom markets, and it was only during the last decade that results of the reforms within the sector have been evaluated in developing countries.

Bhattacharyya, Parker and Raffiee (1994) compared the efficiency of 225 public companies and 32 private companies in USA based on a model of variable cost restricted minimization. The results show a higher efficiency of the public companies regarding the use of production elements and technical capacity. However, dispersion of results for public companies is higher than the one for private companies.

Estache and Rossi (2002) analyze the performance of 50 companies of the drinking water sector in 29 countries of Asia and the Pacific by estimating the stochastic limit of costs. The results do not show a higher efficiency of the private companies when compared to the public companies. Using the same methodology. Coelho, Da Silva and Moreira (2005), compared the efficiency of 148 companies in Brazil, and found that efficiency of private companies is only marginally higher than the public companies.

The African case is analyzed by Kirkpatrick, Parker and Zhang (2006), based on data from 110 companies in 13 countries of the African continent for the period from 1990 to 2001. In addition to the stochastic frontier methodology of costs, the authors estimate an efficient frontier by using Data Envelopment Analysis. Any evidence a superior performance of the private companies over the public companies is found using any of the two econometric techniques. Nonetheless, consistent with the results from

Bhattacharyya et al. (1994), results from the public sector for the efficiency frontier constructed are more homogeneous than those from the public sector.

Clarke, Kosec and Wallasten (2004) carried out a different analysis from the ones described above, as they studied the effect of participation of private sector on the water and sewerage services in Brazil, Argentina and Bolivia. Those authors identified 18 municipalities which have implemented some sort of private participation on the provision of services, and compared them to 28 municipalities that maintained the public sector as their service provider. By using data from household surveys carried out from 1990 to 2001, the authors constructed a panel data and estimated a regression of the service coverage based on a categorical variable of private participation. Population, income per capita and binary variables for each year were introduced as control variables. For none of the two services of water supply and sewerage system, any correlation between private participation and coverage is found. In their conclusions, Clarke et al. state that their results can be interpreted as a confirmation of the hypothesis of competence by reference in water supply and sewerage services, that is to say, that the involvement of the private sector can become a positive leverage for pressing the public providers to improve their performance and quality of the services they provide.

Another approach to the effects of reforms on water and sanitation sector is based on methodologies of cost-benefit analysis. Clarke, Menard and Zuluaga (2000), and Shirley, Xu and Zuluaga (2000) apply this approach to study the process in Conakry and Santiago de Chile, and their results show that reforms benefit both the consumers, as well as local governments and private investors.

The research of Galiani, Gertler and Schargrodsky (2005) studies the effect of privatization on child mortality in Argentina in a group of 494 municipalities. Results from Galiani et al., obtained by applying a difference-in-difference model, indicate that privatization is associated to a decrease in child mortality by 9%, and this effect is focused on municipalities with higher poverty levels.

The work of Giraldo and Rosales (2004), analyzes the effect of access to electricity and drinking water on productivity of households in Colombia, using the theoretical tools of The New Economics of Family. The authors found that the productivity differential explained by the access to those services is $21,640 of 1998, equivalent to 10.5% of the monthly minimum legal wage.

The development of reforms in the sector in Colombia has been studied by Silva and Andia (2006), and they analyze the evolution of mortality in children under 5 in Colombia during the 1998-2002 period, and its relation with coverage of water supply and sewerage services. They also examined the performance of the resources transferred by the central government to the municipalities of the country, and its effect on the service coverage. The authors found a low relation between the allocated resources and the change in coverage, as well as a high heterogeneity of the reform results in different regions of the country. They emphasize on their conclusions that there is a need of an institutional adjustment that promotes the efficient administration of the resources given to the municipalities, and a proper coordination between health policies and the basic sanitation ones.

The impact on consumer welfare of private participation in the water and sanitation sectors is evaluated for the Colombian case by Barrera and Olivera (2007). Based on the data provided by the Survey on Quality of Life and the Survey of Demographics and Health for 46 municipalities in Colombia, Barrera et.al. constructed a panel data and estimate the effect of privatization on coverage, price and service quality by means of a differences-in-differences model, as well as on the incidence of diarrhea in child population. Moreover, the authors include in their analysis the technical capacity of municipal governments measured from the indicators of fiscal performance. The results show a positive effect of private participation on coverage and service quality; this effect, however, is mainly present in urban areas. With regards to the incidence of diarrhea in child population, the results are inconclusive. On the other hand, there was no difference in the behavior of coverage in the municipalities with privatization when compared to those with no privatization but with a high technical capacity, and according to the

authors, these results suggest that those municipalities are able "to compete" with private companies in the provision of the service.

Finally, it is worth highlighting the case study prepared by Arévalo and Schippner (2002) based on the experience of private sector participation in the administration and operation of water and sanitation services in the department of Antioquia. The study analyzes the evolution and performance of 11 small and medium-sized providers serving 38 municipalities, and it evaluates the satisfaction level of water and sewerage service users, among other aspects. Arevalo and Schippner conclude that mixed management strategies turn to be the best choice as they combine the joint interests and efforts of both the public and private sectors.

The wide range of approaches and techniques used for the analysis of the reforms to water and sanitation sectors in different countries shows clearly the importance of setting forth an approach to the effect of reforms that allows to point out the guidelines that the sector policy should follow. After more than ten years of the implementation of the reforms in our country, this paper proposes an empirical measurement of the Colombian case results.

3. PROVISION OF WATER SUPPLY AND SEWERAGE SERVICES IN COLOMBIA

Since 1950 decentralization has been a key element in the provision of drinking water in Colombia. In fact, after that year, there was not a real consolidation of a strictly centralized model regarding the provision strategy applied in the country, but instead service management has been the responsibility of local government entities predominantly (Maldonado and Vargas, 2001). Cost structure for the sector has been a determinant element of the prevalence of this management strategy, specifically due to high costs of water transportation, factor that makes the municipal market the natural optimal scale from the assets point of view (Roda, 2004).

Historically, development of the sector has been affected by political and electoral interference given the big political capital represented by the provision of an essential service as drinking water is. The management of national resources intended for financing of water supply and sewerage systems was under the control of the Fondo de Fomento Municipal (FFM) *(Municipal Development Fund)* until 1950, and then the issue was taken over by Instituto de Fomento Municiapl (INSFOPAL) *(Municipal Development Institute)*. INSFOPAL was in charge of planning, designing, building, operating, maintaining, managing, and financing services in municipalities (Maldonado et al., 2001).

Creation of Junta Nacional de Tarifas (National Board of Pricing) in 1968 addressed the need to "decrease the political interference on the pricing process" for water supply and sewerage systems. The Board decided to create different levels and uses of the resource, i.e., household, commercial, industrial, and official uses. Based on that ranking, rates were defined and allocation of subsidies was initiated. By that time, actions from the Board and INSFOPAL had removed the municipalities from the service provision scenario, and the situation was moving towards a centralized management. This trend was reversed, however, in 1975 when management control of the service was awarded to Empresas de Obras Sanitarias (EMPOS) *(Sanitary Works Companies)*, and Sociedades de Acueductos y Alcantarillados (ACUAS) *(Departmental Water Supply and Sewerage Companies)*, which were entities of INSFOPAL at department and municipal levels (Domínguez and Uribe, 2005).

Sector situation by late 1980's can be placed within the framework of what Spiller and Savedoff (2000) so called a "low-level equilibrium", in which tariffs were low and did not cover the costs associated with expansions in coverage and service quality. Additionally, there was a lack of a pricing mechanism that allowed the rationalization of consumption. Within this scenario, by 1986 reforms in the sector started to rise within the framework of a decentralization policy that was growing in the country.

The sector reforms starting point was the issue of Law 11 of 1986 that established an administrative and fiscal statute with the purpose of allowing the municipalities to deliver the service they are in charge of providing without any interference. Law 12, also of 1986, defined the fiscal element of the reform.

Later on, Decree 77 of 1987 liquidated INSFOPAL, final step towards the path of decentralization of the service. Government equity in EMPOS and ACUAS was transferred to municipalities, but before carrying out the transfer, the government had to pay 256 million dollars in order to bailout those entities that were in a difficult financial situation (Domínguez et al., 2005). As noted by Maldonado and Vargas (2001), however, the legacy of INSFOPAL management to the municipalities was one of delays in coverage and quality of services.

Maldonado et al. (2001) assert that the more affected municipalities by the reforms of 1986-1987 were those with a population ranging from 2,500 to 100,000 people at that time, and that were served by INSFOPAL, as with the presence of that entity, local authorities disregarded the provision of the service. They also point out that the main consequences arising from the decisions made between 1986-1987 were the transfer to the municipalities of functions concerning public works, and the operation and management of service provision; simultaneously, there was also an increase of resources transferred from central government level to municipal level, in the hope of giving the municipalities the required autonomy to develop their new functions. All these measures were targeted to address the need of reaching efficiency in municipal expenditure, and better coverage and quality characteristics.

Although at the beginning the purpose of decentralization was focused on separating the income and responsibilities of the specific government levels, the critical financial situation of the municipalities made clear the impossibility to meet that goal. This was the reason for the fact that as final result of the reforms, the current strategy of allocation of income and expenditures was reached, and it is based on a model of conditioning and complementarity between the nation and the municipalities. Under this model, the

municipal autonomy has been the central point of the reforms, even though the Nation continues to be the main source of financing of the sector investments through the resources transferred to the municipal level. Likewise, the national government carries out technical and financial support functions for the development of the local service infrastructure.

Since the enactment of Law 60 of 1993, municipalities started to receive resources to be spent specifically in the water and sanitation sector. Later on, Law 715 of 2001 defined the distribution by sectors of the resources from the Sistema General de Particpaciones, SGP *(General System of Allocations)* to be received by the municipalities, and this Law considered a percentage to be allocated without restrictions for municipalities of category four, five and six.[7]

Resources allocated by SGP to the sector have been a source of financing for the Colombian Solidary Approach that includes subsidies to the offer and to the demand. Subsidies to demand are allocated following a cross-subsidization approach in which residential users from low socio-economic level (1, 2, and 3) received discounts in their utility invoice that are covered by the contributions of higher socio-economic level users (5 y 6[8]), as well as by the commercial and industrial users. Due to the deficit nature of the approach, SGP finances the subsidies to demand partially. Subsidies to the offer correspond to resources that "cover a fragment of the investment costs either through direct subsidies to the provider or through the delivery of infrastructure, which should not reflect into the amount of the tariff," (Silva, 2007).

Under this approach of transferences, 6.1% out of the 117.5 billion pesos given by the central government to municipalities was allocated to the drinking water sector in the 1994 to 2001 period. (Silva and Andia, 2006). According to estimates given by Silva (2007), resources for investment in drinking water and sanitation reached 1,109 million dollars in 2007, and those resources have increased four times in real terms since 1993.

[7] For a more detailed description of SGP's resources, see Silva and Rozo (2005).
[8] Level 4 does not receive subsidy or pay contribution, that is to say, the service corresponds to the service provision cost.

3.1 Law 142 of 1994 and business transformation in public utility services provision

The possibility of service provision by non-government agents or private agents and the creation of ways for having the user as a participant in the management and overseeing of service provider companies was set forth in the Constitution Amendment of 1991. Furthermore, Article 66 also sets forth that a core purpose of the government should be addressing the basic needs of environment sanitation and drinking water supply in order to improve the population quality of life. Provisions set forth in the Constitution Amendment of 1991 were regulated by Law 142 of 1994 (hereinafter, "Law 142") or Régimen de Servicios Públicos Domiciliarios *(Regime of Household Public Utiliies)*.

Law 142 introduced a new institutional framework for the household public utilities provision with the creation of the Regulatory Committees, one for each sector of Telecommunications, Energy and Gas, and Drinking Water and Sanitation; and also the regulation of the Superintendency of Household Public Services (SSPD), established by the Constitution Amendment of 1991.

Under this new framework, the nation is responsible for the services planning, regulation, oversight and control, and the provision is carried out by the provider, that can be one of the following : 1) public services companies incorporated as public limited liability companies (S.A. ESP), 2) municipalities as direct providers, 3) government-managed industrial and commercial companies (EICE, Empresas Comerciales e Industriales del Estado), 4) marginal or independent producers, and 5) organizations authorized to provide service in rural areas or specific urban areas[9].

This new institutional framework acknowledges the role of municipalities as the central pivot of the provision of services by vesting in them the responsibility of providing efficient household public utilities, whereas departments are vested only with supporting and coordinating functions of the provider entities. The task vested to the municipalities

[9] Law 142 of 1994, Article 15.

can be delivered through public services companies or directly by the municipality, in case of the unavailability of a company willing to taking up the provision of services.

The main changes introduced by Law 142 are: Definition of a tariff regime based on the cost of providing the service, creation of a control mechanism enforced by citizens of the provider performance, establishment of a regime of free enterprise which constitutes the defining element for the entry of the private sector to the service provision area, and for the implementation of management control and internal control systems within the provider companies[10].

Also, Law 142 proposed[11] the promotion of management models that ensure effectiveness and efficiency in the provision of public services, both measured in terms of meeting the coverage and quality targets. The foregoing statement does not exempt the government from its obligation to ensure the provision and coverage expansion of basic public utilities (in this case, water supply, sanitation and electric power).

During the process of drafting Law 142, it was assumed, as general approach, that public utility companies *(empresas de servicios públicos, ESP)* would be in charge of providing the services, because adoption of a business-like model was considered to be the best way to reach the level of efficiency in service provision required by the Constitution Amendment of 1991.[12] This approach was based on a clear prejudice, i.e., that service provision managed by municipal authorities could not be isolated from the inefficiencies associated with the political interference in the service provision management. Since the 1980's, such prejudice was fully accepted by the developing countries when implementing the reforms in the different sectors. As described in Section 2, however, many studies have shown that this concept must not be accepted as a generalization.
In spite of the fact that service provision through ESPs (Public Utility Company) was intended to be the general approach for the sector, the regulator left the possibility open

[10] Law 142 of 1994, Articles 87, 62, 10 and 45.
[11] Law 142 of 1994, Article 3.
[12] Statement of intends, Regime of Household Public Utilities (Exposición de Motivos, Régimen de Servicios Públicos Domiciliarios) – Draft Law

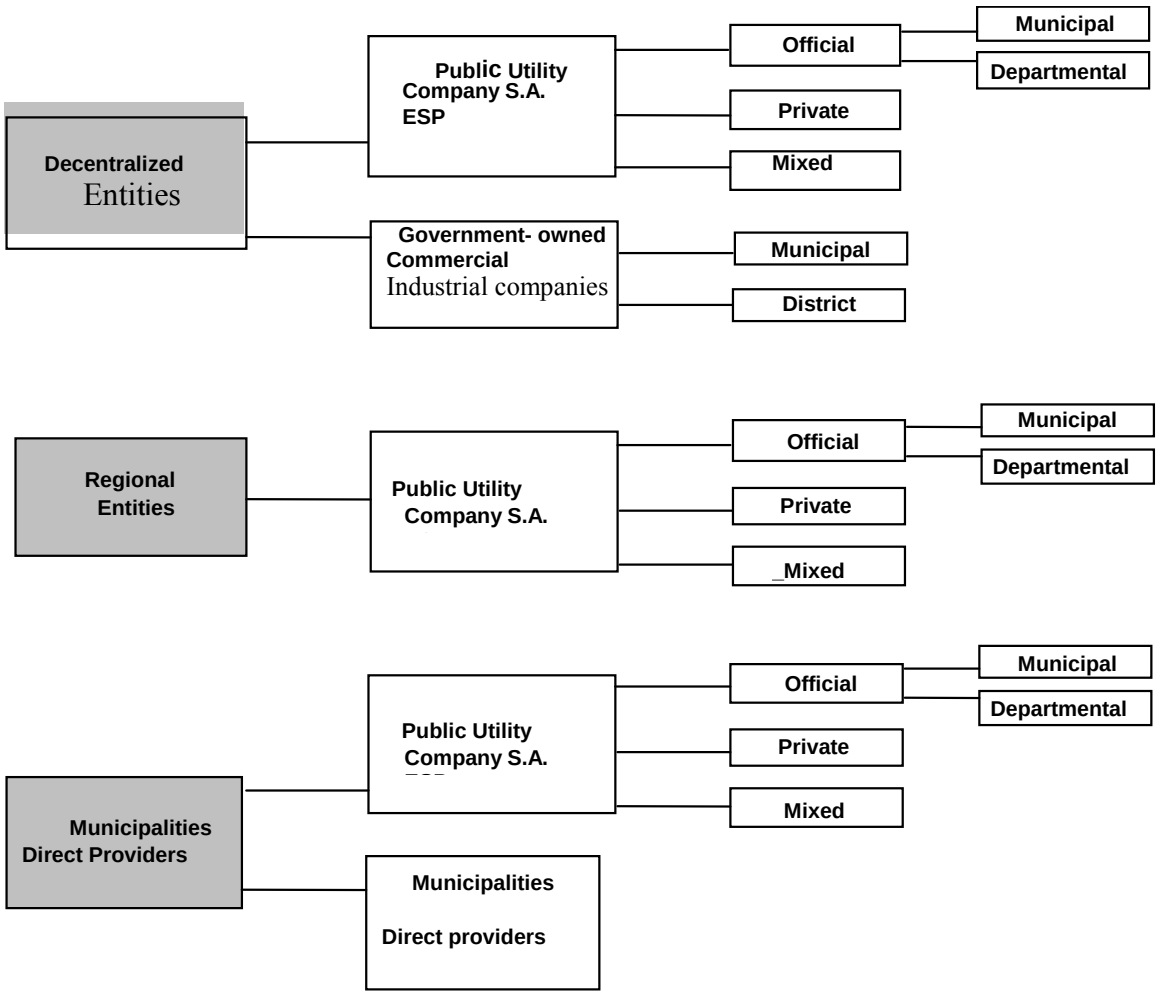
for the municipalities to be the direct service provider, without being excluded from applying control models to management and results promoted by Law 142 as mechanisms to improve efficiency in public utilities provision. On the contrary, Law 142 states clearly on Article 6.4 that direct provision by municipalities is subject to the same terms and conditions as any other kind of entity, such as Public Utility Companies (ESPs).

The transformation into a business-like management model of the decentralized entities and regional entities that provided direct household public utilities was regulated by Articles 180 and 182 of Law 142, respectively. In both cases, said entities should form an ESP for the public utility provision. Article 6, however, offered the possibility of direct provision by municipalities[13], where setting up of an ESP was not possible. In the case of decentralized entities, Article 17 offers the option of setting up an EICE[14]. Figure 1 shows the chart of the transformation into a business-like management model proposed by Law 142.

[13] Exception considered by Article 6 does not apply for combustible gas provided by network .

[14] Law 286 of 1996 ordered that all decentralized entities and companies that provided services, including Empresas Industriales y Comerciales del Estado EICE *(Government-managed industrial and commercial companies)* formed after 1994 should be transformed into empresas de servicios públicos, ESP *(public utilities companies)*. For the purposes of this paper, the transformation process was accomplished with the initial setting up of an EICE, and not with the subsequent change in legal status to become an ESP.

Figure 1 Chart of the transformation into business-like management model proposed by Law 142 of 1994



Source: Author based on Law 142

Results of implementing the transformation into a business-like management model in the country indicate that for the water supply and sewerage services case, the characteristic considered to be an exception has actually become the majority, as municipalities as direct providers represent now about 51%[15] of the total provider entities.

Although on preliminary draft of Law 142 the concept that replacing municipalities as direct provider by a Public Utility Company would contribute to reaching the service

[15] Silva (2007)

coverage and quality goals was supported, and it would result in better population quality of life indicators, today corroborating evidence for this approach is not conclusive. This paper seeks to address that question by analyzing the reform effect on the provision of water supply and sewerage services, understood as starting of operation by a provider other than the municipality, and on the population quality of life. With this purpose in mind, this paper considers the mortality of children under 5 from infectious and transmissible diseases in each municipality as a quality of life indicator, given its close relation to the access to water supply and sewerage services.

Establishing whether or not the increase in coverage was an effective mean of transfer of the reform effect on child mortality in children under 5 is set out as additional objective of the paper. Regarding this point, it is important to clarify that under the strategy of allocation of resources in which the sector has operated, coverage increase is not necessarily one of the objectives of the service provider, because investments in infrastructure to extend service access can be covered by resources from the central government. On the other hand, as providers are interested in receiving demand subsidies to cover their costs based on the tariffs, resources assigned to infrastructure can be reduced, thus affecting the dynamics of coverage increase.

3.2 Reforms to provision of water supply and sewerage services: Descriptive Statistics

In order to develop the abovementioned objective, data compiled from the companies registered as water supply and/or sewerage service providers before SSPD in March, 2007 were used. Out of a total of 780 registered companies, 422 provided both services, 345 only provided water supply service, and 13 only provided sewerage service. Table 1 shows the distribution of companies according to the type of provider each one represents, as defined within Law 142.

Table 1 Number of companies registered before the SSPD and municipalities served, according to type of provider

TYPE OF PROVIDER	REGISTERED COMPANIES			MUNICIPALITIES SERVED	
	Water and Sewerage	Only Water supply	Only Sewerage System	Water supply	Sewerage system
EICE	142	14	2	169	154
Municipality	190	21	7	213	188
Authorized organization	32	292	0	329	32
Marginal Producer	3	11	0	14	3
Sociedades (ESP)	55	7	4	163	142

Source: SSPD, own calculations

The number of served municipalities according to type of provider is also summarized in Table 1. The 780 companies registered before the SSPD operate in 623 municipalities in the country.

For the last sample, only municipalities served by a EICE, a S.A. ESP company, or directly by the municipality were included. Authorized organizations and marginal producers were excluded because they were not capable of becoming an incorporated company. The total of the sample is made of 550 municipalities; in this group, municipalities that underwent a reform of service provision between 1994 and 2004 were included, as well as those in which service provision was kept as responsibility of the local government. Reform was carried out by forming an ESP company as responsible for the provision of water supply and/or sewerage service.

Calculations were made out of 545 municipalities with access to water supply service and 484 with access to sewerage service. Analysis was made in the period between 1990 and 2004. As of 1994, with the enactment of Law 142 of 1994, the possibility of implementing a reform to the service provision in municipalities where provision was the responsibility of local government or regional entities was open.

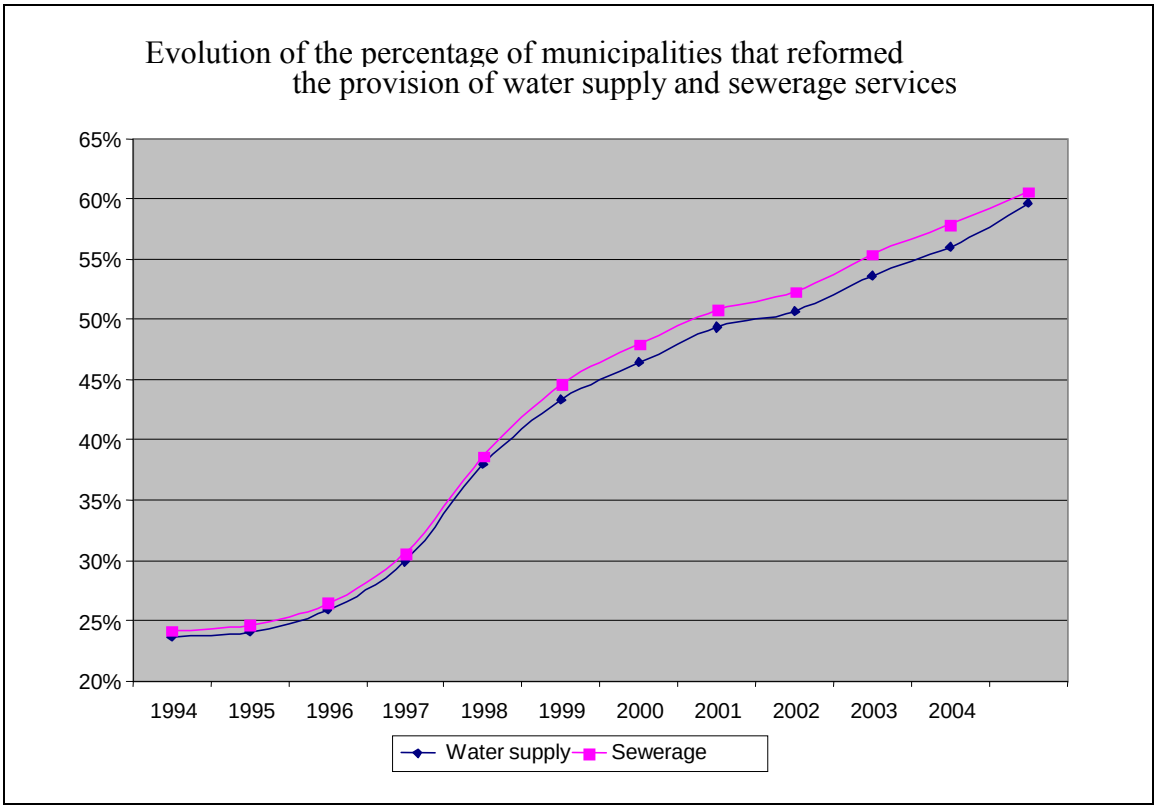
Based on the date the new companies (EICE or ESP) started operating, the actual date when that company became a water and/or sewerage service provider was determined for each specific municipality, i.e., the year when the provision of each service was reformed. A reform variable was constructed based on these data. In this way, for each

municipality, the variable Reform takes the value of 1 for a given year, if during that year the service was delivered by an EICE or an ESP previously incorporated. If not, the variable takes the value zero. A variable reform was built for the sewerage service in a similar way.

Graphic 1 illustrates, for the sample municipalities the evolution of the percentage of municipalities that reformed the service provision from 1994 to 2004.

The number of municipalities in which water and sewerage services were provided by the local government was reduced from 416 to 220 in the period between 1993 and 2004. For sewerage service, the decrease was from 367 to 191. That is to say, only 47% of municipalities reformed the provision of services, 194 reformed water provision, and 174 reformed sewerage service provision. Larger municipalities were more attractive to provider companies, and as a result, this group concentrated more reforms than other groups. Out of the municipalities that reformed service provision, 87% is served by companies with more than 2500 subscribers.

Graphic 1 Evolution of the percentage of municipalities that reformed the provision of water supply and sewerage services



Source: SSPD, own calculations

As shown in Table 2, the majority of municipalities that implemented a reform in service provision decided to set up an EICE, and only 43% of reforms in service provision were implemented through ESP incorporated companies. The involvement of private participation in service provision was implemented in 80 out of the 84 municipalities that implemented a reform through the setting up of a Public Utility Company, S.A. ESP. Only in 5% of the municipalities, ESP was created with exclusively official-capital, and in 82%, totally funded with private capital.

According to figures in Table 2, although around half of the analyzed municipalities implemented a reform to provision of water supply and/or sewerage services between 1994 and 2004, private investment only reached 80 municipalities out of 623 analyzed, to a 13%.

Table 2 Type of provider set up by municipalities that reformed service provision

TIPO DE PRESTADOR	SERVICIO			Total	%
	Water supply and sewerage	Only water supply	Only sewerage		
EICE	101	9	2	112	57%
Incorporated companies (ESP)	71	13		84	43%
Official	*4*			*4*	*5%*
Private	*58*	*11*		*69*	*82%*
Mixed	*9*	*2*		*11*	*13%*

Source: SSPD, own calculation

4. CHILD MORTALITY AND ACCESS TO WATER SUPPLY AND SEWERAGE SERVICES

The relation between provision of drinking water and sanitation on the one hand, and public health indicators on the other is widely acknowledged in related literature (Esrey et al, 1991). Specifically, the lack of access to water supply and sewerage services is associated with incidence of infectious and transmissible diseases because it increases the possibility to ingest contaminated water and makes personal hygiene difficult to attain (Payment y Hunter, 2001). Behaviors of coverage of water supply and sewerage services and child mortality rate in the 550 municipalities included in the study are presented below.

4.1 Evolution of coverage of water supply and sewerage services

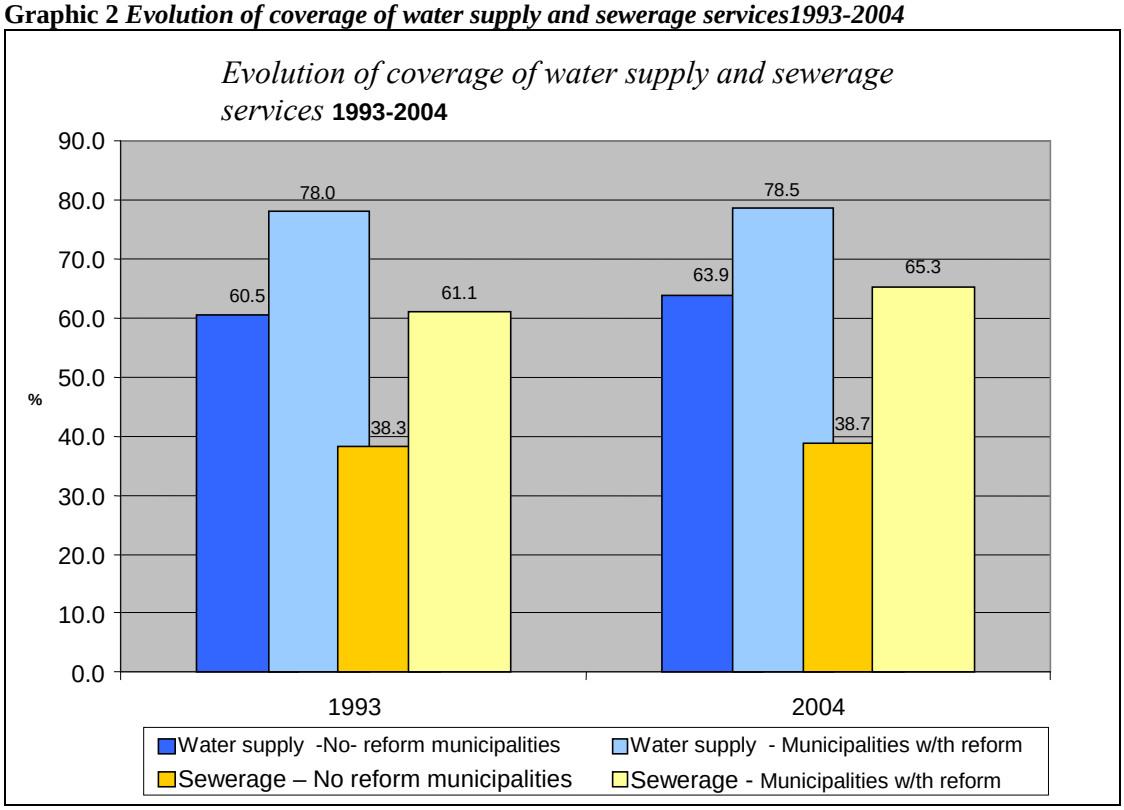
Coverage of water supply and sewerage services was calculated from census data corresponding to years 1993 and 2005 as the percentage of households with water supply and sewerage service in each municipality. It is important to clarify that these coverage figures only measure access to services, but not continuity and quality of services; in this sense, they are nominal coverage figures, not real coverage figures.

Coverage of water supply and sewerage services in the municipalities analyzed increased by 7.8 and 9.8 percentage points respectively, between 1993 and 2005. During that period, coverage of water supply service raised from 64.8% to 72.6%, and sewerage

coverage, from 42.5% to 52.3%. In spite of these increases, coverage lag for water supply compared to sewerage coverage only decreased in 2 points of percentage.

A more specific exam of coverage figures is presented in Graphic 2, which shows the differences among municipalities, according to implementation of reforms in service provision. Although in 1993 reforms had not been implemented in the sector, municipalities with reform means those in which service provision was not operated by local government entities, but by specialized operator.

Graphic 2 ***Evolution of coverage of water supply and sewerage services1993-2004***



Source: DANE, calculations by author

As it is shown in the Graphic, municipalities that continued with direct provision of water supply, coverage increases by 3.4%, in contrast to municipalities that implemented reforms in provision, in which the increase was only 0.52%. An opposite trend is detected for the sewerage service, as coverage in the first group of municipalities only increased by 0.47%, and in the second group, by 4.24%. As a result of this behavior, coverage lag for sewerage coverage when compared to water supply coverage decreased by almost 4

percentage points in municipalities that reformed service provision, and in those that did not reformed provision, it decreased by 3%.

Although the differences in coverage increase are related to its starting level, which was lower in municipalities lacking reform, the methodology used in Section 6 allows to capture the reform effect on coverage considering the starting levels and controlling the remaining particular factors for each municipality.

4.2 Evolution of child mortality rate

Mortality rate was constructed based on number of child under 5 deaths registered in the sample municipalities between 1990 and 2004. Data include 184,007 deaths sorted by cause of death, according to List 6/67 of International Classification of Diseases, ICD-10. Child mortality rate was calculated for each year as the ratio between the number of deaths registered in a municipality and population between 0 and 4 years old.[16]

During the analysis period of 1990 to 2004, death of children under 5 went from 13,382 to 10,381, which indicates a decrease by 19%. However, dropping of child mortality rate was much more significant, as it went from 1.27% in 1990 to 0.20% in 2004. In 1990, 8.4% of child deaths were caused by infectious and transmissible diseases, and by 2004, the percentage went down to 4.4%.

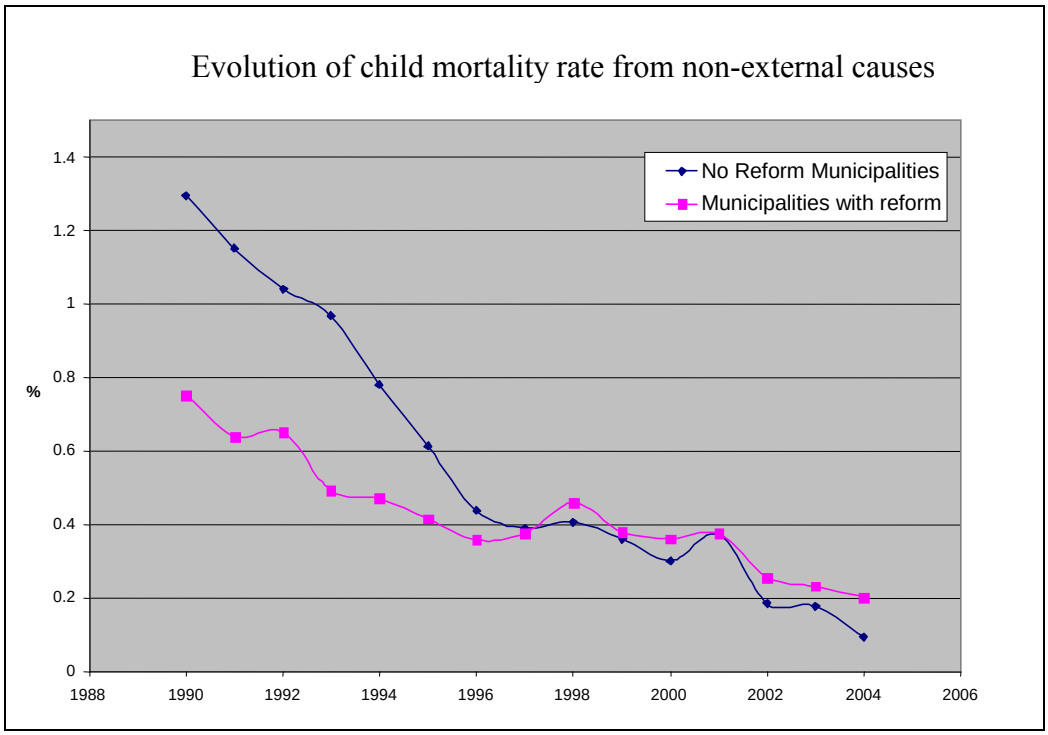
In the analysis, two variables of child mortality were constructed. For the first variable, all registered deaths were considered, except 12,947 that were classified within the group of deaths from external cause. For the second variable, only the 23,595 deaths caused from infectious and transmissible diseases were considered, as those diseases were the ones with a direct association to lack of water supply and sewerage services.

During the analysis time period and for the sample municipalities, child mortality rate from non-external causes decreases from 1.16% to 0.15%, and the rate from infectious

[16] In this document, this definition of child mortality rate will be the one used. However, in the literature, child mortality rate is defined as the number of deaths of children between 0 and 1 per 1000 born live.

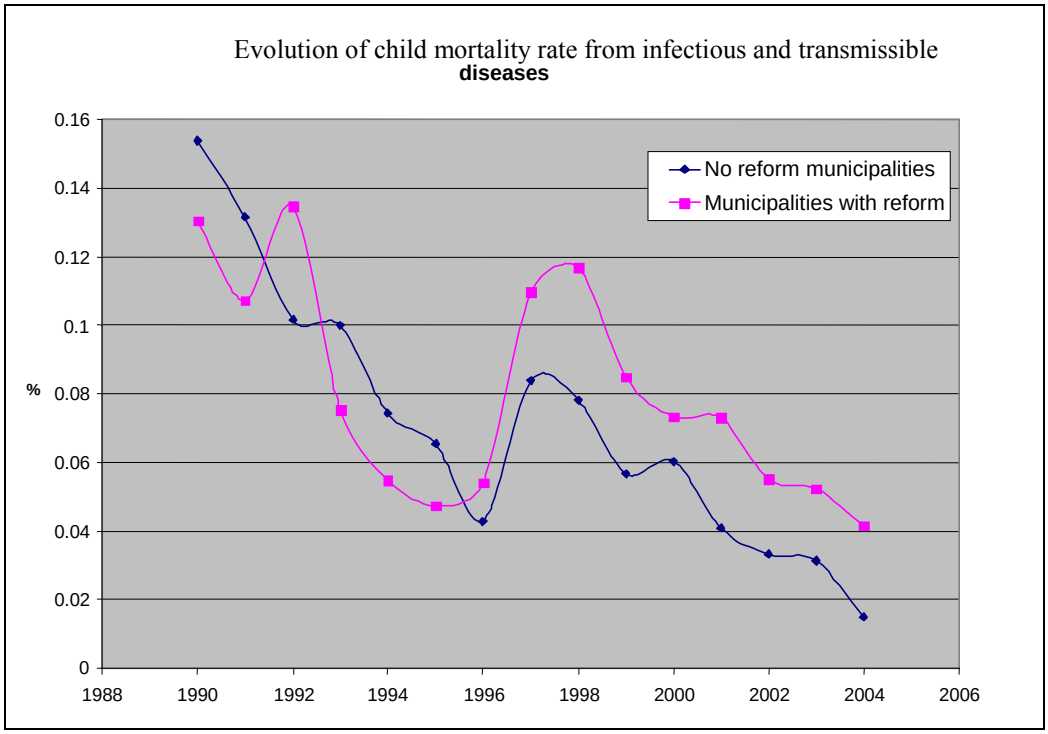
and transmissible diseases declined from 0.15% to 0.03%. However, there exist differences in the behavior of child mortality rate in municipalities that reformed the provision of water supply and/or sewerage services when compared to the one in municipalities that did not reform such provision, as shown in Graphic 3 and 4.

Graphic 3 Evolution of child mortality rate from non-external causes



Source: DANE, calculations by author

Graphic 4 Evolution of child mortality rate from infectious and transmissible diseases



Source: DANE – Vital Statistics, calculations by author

In 1990, municipalities that provided services directly exhibited an average higher mortality rate than those where a company was in charge of the provision. This tendency is inverted during the analysis period, and in 2004, municipalities that provide service directly exhibited a mortality rate lower than those that reformed the provision.

Graphic 3 and Graphic 4 present evidence of the response observed in the mortality rate to the implementation of reforms in the provision of water supply and sewerage services, which represents the subject matter to analyze in this paper. However, in order to obtain an estimate of the impact extent of service provision reforms on mortality, it is necessary to make an econometric approximation that incorporates the particular characteristics of each municipality on one hand, and the global temporal tendencies of child mortality on the other, in addition to an exact measurement of the year the reforms were introduced in each municipality. In Section 6, the analysis methodology used to include all this characteristics is described, as well as the results obtained.

5. THE DECISION TO REFORM THE PROVISION OF WATER SUPPLY AND SEWERAGE SERVICES

Law 142 defined the following situations, included in the order they appear in the Law, as the ones in which a municipality would be allowed to continue as direct provider of water supply and sewerage services: 1) In case there is not a company interested in providing the service; 2) in case other municipalities, the department or other entities are not interested in forming a Public Utility Company; and 3) in case although there could be companies interested in providing the service, the costs of direct provision are lower than those of said company or companies.[17]

In accordance with these restrictions, it is very plausible that more ESP were formed in the largest municipalities, or those that can group together with other municipalities to form a market that allows costs recovery by those companies. Indeed, as it was mentioned above, on the analyzed sample, 87% of reforms were implemented in municipalities served by companies with more than 2500 subscribers.

A first hypothesis that can be stated is then that the possibility that there is an entity interested in providing the service is related to the socio-economic characteristics of municipalities and to its evolution in time. On the other hand, another hypothesis than can be posed refers to the effect of the political commitment of local governments to either promote the participation of a company in the provision, or the continuity of direct provision.

With the purpose to identify the elements that affected the decision to reform, the probability that a municipality makes the decision to reform the service provision through the formation of a company is estimated using a Logit Model. As shown in Table 3[18], two models were used. In the first one, the socio-economic characteristics of the

[17] Law 142 of 1994, Article 6.
[18] In the Appendix: Definition of Variables, a detailed description of each one of the variables used and its corresponding source is included.

municipality (Unsatisfied Basic Needs (UBN), (*Necesidades Básicas Insatisfechas, NBI*)), rurality rate, land distribution, tax revenue, and child mortality rate) vary through time. In the second one, the figures of these variables in 1993 were included, as well as one-year lagged difference in land distribution, tax revenues, and child mortality. The inclusion of these three lagged variables seeks to identify if the decision to reform is related to changes of socio-economic indicators of the municipality.

Both models include service coverage, percentage of dwellings sheltering more than 4 households, and percentage of population with a complete high-school level education in 1993. Additionally, two variables were included as indicators of the municipality political situation: participation in elections and effective number of political parties (ENP) *(NEP, Número efectivo de partidos)* functioning in the municipality. Finally, the variable duration measures the number of years that have passed until the moment the municipality implements the reform; this variable was included to examine if there exists a dependency of duration in the probability to reform.

Results show that probability to reform exhibits a positive dependency of duration. For the two services and in both models, initial coverage is significant, and it affects the possibility to reform positively. This result does not support the purpose set out by the regulator of increasing access through provision by Public Utility Companies, as the result shows that reforms are not directed to regions with the widest problems in coverage. The foregoing is consistent with the negative impact exhibited by the rurality rate in both models for the case of water supply service, given the lag existing when comparing rural and urban coverage rates. In this sense, a municipality with a high rate of rurality will have a lower coverage than one with population concentration in its urban area, and as a result, a reform in service provision is less likely to be implemented. Regarding the political variables, the findings show that whereas the electoral participation decreases the probability of a reform, the NEP *(effective number of political parties)* increases that possibility.

Table 3 Results of Logit Model of the probability of reforming service provision

Resultados Modelo Logit de la probabilidad de reformar la prestación de los servicios				
	Acueducto		Alcantarillado	
	Modelo 1	Modelo 2	Modelo 1	Modelo 2
Log_duración	1.789 **	2.138 **	2.009 **	2.304 **
	(0.755)	(0.891)	(0.944)	(1.040)
Características municipales en 1993				
Cobertura	0.018 **	0.021 **	0.017 **	0.018 *
	(0.0079)	(0.009)	(0.008)	(0.001)
% de viviendas con mas de 4 hogares	0.141	0.292	0.283	0.449
	(0.224)	(0.246)	(0.261)	(0.286)
% poblacion con secundaria completa	-0.011	0.003	-0.003	0.009
	(0.0432)	(0.049)	(0.048)	(0.054)
NBI		0.013		0.013
		(0.011)		(0.012)
Tasa de ruralidad (4)		-0.019 *		-0.016
		(0.011)		(0.012)
Coeficiente de GINI		0.884		0.384
		(1.268)		(1.39)
Ingresos tributarios		3.372		3.830
		(5.424)		(5.988)
Tasa de mortalidad infantil		-0.088		-0.147
		(0.115)		(0.129)
Variables que cambian en el tiempo				
NBI	0.006		0.006	
	(0.0089)		(0.010)	
Tasa de ruralidad	-0.019 **		-0.017 *	
	(0.009)		(0.010)	
Ingresos tributarios	4.441		4.102	
	(2.315)		(2.548)	
Coeficiente de GINI	0.915		0.714	
	(1.135)		(1.271)	
Tasa de mortalidad infantil	-0.079		-0.049	
	(0.233)		(0.252)	
Participación	-2.283 ***	-2.387 ***	-2.611 **	-2.775 ***
	(0.8789)	(0.916)	(1.037)	(1.043)
NEP	0.358 ***	0.374	0.331 **	0.339 **
	(0.119)	(0.126)	(0.132)	(0.136)
Δcoeficiente de GINI-1		12.901		19.109
		(30.204)		(32.667)
Δingresos tributarios-1		-0.886		-1.419
		(3.609)		(3.537)
Δtasa de mortalidad infantil-1		-0.179		-0.205
		(0.180)		(0.188)
Constante	-5.983	-7.018	-5.999	-6.659
	(2.078)	(2.475)	(2.362)	(2.671)
Número de observaciones	2278		2018	
Número de municipios	357		318	
*** Estadísticamente diferente de cero a un nivel de significancia de 0.01				
** Estadísticamente diferente de cero a un nivel de significancia de 0.05				
* Estadísticamente diferente de cero a un nivel de significancia de 0.1				

Finally, child mortality rate is not correlated to the decision of reforming service provision in any case. This result is relevant as it allows to establish a causal relation between the service provision reform and the mortality rate, without incurring in a problem of endogeneity.

6. EFFECT OF REFORMS ON CHILD MORTALITY

Due to the strong relation between access to water supply and sewerage services and infectious and transmissible diseases, child mortality caused by these diseases is the variable used to evaluate the effect of service provision reform on the population quality of life.

The purpose was to identify the effect of reform in the provision of water supply and sewerage services on child mortality rate. That is to say, the difference in the child mortality rate for the municipalities that reformed the provision of water supply and sewerage services compared to those who kept a direct service provision. It is necessary to consider, however, that child mortality may be affected by other non-studied variables, which in turn, may have affected the decision to reform service provision. These non-observed characteristic may be typical for each municipality, but constant through time, or they may be shared by all municipalities and change over time. In order to find the reform effect and control non-observed variables, a model of difference-in-difference was estimated from a panel data following the specification:

$$m_{it} = \alpha R_{it} + \beta x_{it} + \gamma_t + \delta_i + \varepsilon_{it} \qquad \textbf{(1)}$$

Where m_{it} is the child mortality rate in the municipality i in year t, R_{it} is the categoric variable of reform constructed as described in Section 3.2, x_{it} is a vector of characteristics that change in different municipalities and through time, γ_t is a temporal effect common to all municipalities, δ_i is an identifier of municipality i that includes its particular characteristics, and ε_{it} is the error term that varies in different municipalities and through time. Coefficient α is the difference-in-difference estimator which indicates the average effect of the reform on child mortality rate.

Although terms γ_t and δ_i in (1) capture the effect of non-observed variables, the estimation entails another problem which arises from the heterogeneity in the distribution of variables that affected the decision to implement a reform, between the municipalities

that reformed the service provision and those which did not reform it. As a result of this heterogeneity, the mistake of comparing a municipality that reformed provision to another that did not reform it is made, but the latter municipality is not comparable to the first one because of its observed characteristics. The solution to this problem implies the identification of municipalities that are not comparable, and exclude them from the sample.

In order to identify the non-comparable municipalities and find the common support region, following Rosembaum and Rubin (1983), the probability of reforming the provision based on the observed variables during the time before the implementation of the reforms was estimated. In this case, a Probit Model of variable Reform in 2004 was estimated, based on the characteristics of municipalities in 1994. The probability estimated according to (2) is known as "Propensity Score", PS, and allows to identify the non-comparable municipalities, and therefore, to establish the common support.

$$PS_i = p(X_i) \equiv P\langle R = 1 \,|\, X_i \rangle \qquad \textbf{(2)}$$

According to PSs estimated, two groups of municipalities were excluded from the sample: 1) Municipalities which did not reform and had a PS lower than the minimum of the municipalities that reformed; and 2) municipalities that reformed and had a PS higher to the maximum of the municipalities that did not reform.

Model (1) was estimated initially with mortality rate from non- external causes as independent variable. Then, the mortality rate from infectious and transmissible diseases was used for the estimation[19], in this case, regression was restricted to values over zero because in many municipalities there were no records of deaths caused specifically by infectious or transmissible diseases for one or more years. In both cases, estimation was performed with the total sample and with the restricted sample as well, according to PS of municipalities. In

[19] In the Appendix: Definition of Variables, a detailed description of each one of the variables used and its corresponding source is included.

Table 4 the results obtained are shown.[20]

Variable Reform before 1994 was included as a control for the municipalities in which service provision was already the responsibility of a company before the enactment of Law 142. For the municipalities that reformed, variables of the interaction of the reform with involvement of private capital in the provider entity, and the number of subscribers were constructed. These variables make it possible to identify if within the municipalities that reformed, the effect on mortality is different if the provider company is private or mixed, or if it provides the service to more than 2500 subscribers.

Results in Columns 1 and 2 of

Table 4 show that reform did not affect the mortality rate from non- external causes in a significant way. Nonetheless, in the municipalities that reformed, involvement of private capital causes a decrease on the mortality rate, but this rate is almost 0.25 percentage points higher in municipalities where the provider entity provided service to more than 2500 subscribers.

Estimating the model considering the mortality rate from infectious and transmissible diseases (Columns 3 and 4 in

Table 4), the effect of the involvement of private capital is not significant, but, on the other hand, reform is associated to a decrease of 0.073 percentage points on the mortality rate. When the sample is restricted according to the PS of the municipalities, the effect is lower, 0.046%. The effect of the number of subscribers in the municipalities that

[20] Estimations were made using data for the reform in water supply service, as in most municipalities, both services of water supply and sewerage are delivered. Results are the same when estimating the model using only data of sewerage service provision.

reformed is again significant, but the coefficient obtained of 0.14 is lower than the one for the mortality rate from non-external causes. This result shows that in the municipalities that reformed the service provision, those with more than 2500 subscribers exhibit an average rate of mortality higher by 0.14% than the one in small municipalities, i.e., less than 2500 subscribers. When analyzing the relative impact of number of subscribers, however, this impact is higher in the model with the mortality rate from infectious diseases. The foregoing due to the fact that mortality rate from external causes in 1990 was around 1.16%, whereas the rate from infectious and transmissible diseases for the same period of time was 0.15%.

Table 4 Results of estimation of reform impact on child mortality rate

Efecto de las reformas en la prestación de los servicios en la mortalidad infantil				
Variable independiente	Tasa de mortalidad infantil por causas no externas		Tasa de mortalidad infantil por enfermedades infecciosas y trasmisibles [a]	
	Muestra total (1)	Observaciones con common support (2)	Muestra total (3)	Observaciones con common support (4)
Reforma	-0.057	-0.016	-0.073 ***	-0.046 *
	(0.052)	(0.053)	(0.022)	(0.026)
Reforma antes de 1994	-0.384 ***	-0.358***	-0.072 ***	-0.076 ***
	(0.044)	(0.051)	(0.016)	(0.023)
Reforma*Privada_o_mixta	-0.225 **	-0.221 *	-0.031	-0.031
	(0.098)	(0.099)	(0.039)	(0.046)
Reforma*Mas de 2500 suscriptores	0.264 ***	0.257 ***	0.142 ***	0.142 ***
	(0.074)	(0.080)	(0.027)	(0.034)
Reforma*Mas de 2500 suscriptores *Privada_o_mixta	0.305 **	0.244 *	0.048	0.043
	(0.127)	(0.142)	(0.046)	(0.061)
Afiliados RS	-0.419 ***	-0.400 ***	-0.211 ***	-0.184 ***
	(0.071)	(0.085)	(0.038)	(0.049)
Ingresos tributarios	1.037 **	1.286 ***	0.308	0.257
	(0.402)	(0.435)	(0.205)	(0.288)
Coeficiente de Gini	-1.042 **	-1.068 **	-0.208	-0.073
	(0.449)	(0.504)	(0.176)	(0.266)
NBI	0.005 *	0.001	0.002	0.0004
	(0.0028)	(0.003)	(0.001)	(0.002)
Log_Población	0.279 ***	0.056	-0.041	-0.119 **
	(0.086)	(0.096)	(0.039)	(0.052)
Tasa de ruralidad	-0.001	-0.002	0.002 *	0.002
	(0.003)	(0.003)	(0.001)	(0.001)
Constante	-0.997	1.539	0.712	1.497
	(0.867)	(0.929)	(0.418)	(0.526)
Número de observaciones	7725	6435	3332	2386
Número de municipios	515	429	380	307
R2	0.0031	0.0374	0.2010	0.2034
*** Estadisticamente diferente de cero a un nivel de significancia de 0.01				
** Estadisticamente diferente de cero a un nivel de significancia de 0.05				
* Estadisticamente diferente de cero a un nivel de significancia de 0.1				
[a] Se restringió la regresión a las obervaciones para las cuales la tasa de mortalidad infantil era mayor a cero				

When considering both effects, the effect of the reform and the one of number of subscribers, the mortality rate in municipalities with more than 2500 subscribers that reformed the service provision is higher by 0.096% than the rate of municipalities that did not reform, under the estimation with common support.

Finally, the enrollment to the subsidized regime is associated to a decrease in both types of mortality rates, and its impact remains constant in the regression with the restricted sample according to the PS of the municipalities.

7. EFFECTS OF THE REFORM ON WATER SUPPLY AND SEWERAGE SYSTEMS COVERAGE

Impact of the reform on child mortality shown in the preceding section can be seen through different mechanisms: Increase in service coverage, improvement in service in terms of water quality and provision continuity, and finally, expense associated to those coverage and quality improvements. As a result, impacts of reform on coverage and quality of water supply and sewerage services reflect in lower mortality rate from infectious and transmissible diseases. In this section, the effect of the reform on coverage of water supply and sewerage services is analyzed.

The effect of the provision reform on service coverage was evaluated from data of coverage of water supply and sewerage systems from Census of 1993 and 2005. A model of difference-in-difference with a panel data from two time periods was estimated following the specification:

$$Cob_{it} = \alpha R_{it} + Bathroom\_2005 + \phi(R * More\_than\_2500)_{it} * + \gamma(R * \text{Pr}ivate\_mixed)_{it} + \delta_i + \varepsilon_{it} \quad \textbf{(3)}$$

In this case, the independent variable, Cob_{it} is the coverage of service (water supply or sewerage system) of municipality *i* in year *t*. The estimator of difference-in-difference α, compares the change in coverage in municipalities that reformed provision, to the change in municipalities that maintain a direct service provision. Variable *Year_2005* summarizes the temporal effect shared by all municipalities. Two terms of interaction of variable *R* were included, with two categoric variables *More_than_2500* and *Private_Mixed*. The first equals 1 if the company providing the service in the municipality serves more than 2500 subscribers, and the second equals 1 if the company involves private capital, that is to say, whether it is a private or a mixed company. These terms of interaction make it possible to determine if for the municipalities that implemented reforms, coverage results were different when the company served more than 2500 subscribers than the ones where there is private sector involvement. Finally, δ_i represents the particular characteristics of a municipality.

The results obtained are shown in Tabl6 5. It was found that water supply coverage was increased by an average 12%, and sewerage coverage by 9%. Reform only has a significant impact on sewerage coverage. Municipalities that reformed the service provision reached, in average, coverage that was 4.6% higher than coverage in municipalities that maintained a direct provision.

Tabl6 5 Impact of reforms on service coverage increase

Efecto de las reformas en la cobertura de los servicios Estimación de diferencias en diferencias con efectos fijos		
	Acueducto	**Alcantarillado**
Año 2004	12.356 ***	9.1857 ***
	(1.253)	(0.3195)
Reforma	0.17752	4.627 *
	(2.299)	(2.413)
Reforma*Mas de 2500 suscriptores	-6.163 ***	-1.079
	(2.22)	(2.332)
Reforma*Privada_o_Mixta	-6.275 ***	-1.843
	(2.26)	(2.428)
Constante	64.3	43.75
	(0.56)	(0.58)
R2 Within	0.238	0.305
R2 Between	0.166	0.051
Observaciones	1044	932
Municipios	545	484
*** Estadisticamente diferente de cero a un nivel de significancia de 0.01		
* Estadisticamente diferente de cero a un nivel de significancia de 0.1		

In municipalities that reformed provision, increase in water supply coverage in municipalities with more than 2500 subscribers was 6 percentage points lower than the one in municipalities with less than 2500 subscribers. Regarding the sewerage service, the difference is not significant. This result is consistent with the one obtained for the reform impact on child mortality, since as it was shown above, in municipalities that reformed service provision, those served by companies with more than 2500 subscribers showed a higher child mortality rate. From the results obtained regarding coverage, it is possible to conclude that a segment of that difference can be attributed to a higher increase in coverage in municipalities with less than 2500 subscribers.

Finally, and contrary to the findings regarding child mortality, there exists a difference in the changes in coverage when private capital is involved in reforms to water supply service provision. For municipalities that reformed provision through private or mixed companies, increase in coverage was 6 percentage points lower than the one for the rest of municipalities that reformed.

Due to the lack of measurements of the initial level of water quality provided to the user, this variable was not included in the analysis. Quality of water provided to the user begins to be evaluated in 2004 by the Defensoría del Pueblo *(People's Advocacy Entity)* from data gathered by the Health Secretariat of each municipality, and there are results available for 2005 and 2006.

8. CONCLUSIONS

Estimation of a difference-in-difference model allowed to control the particular characteristics of each municipality in order to establish the effect of reform in water supply and sewerage service provision on child mortality. Results indicate that municipalities with more than 2500 subscribers and that reformed service provision exhibit a child mortality rate from infectious and transmissible diseases higher that the one in municipalities that maintained service provision on the hands of local government. The estimated difference was 0.096% (approximately 19% of the mean mortality rate for 1990.)

Private sector participation in the provision of water supply and sewerage services is not related to the decrease in child mortality from infectious and transmissible diseases.

With respect to expansion of service coverage, the reform had a positive impact on sewerage service coverage. Municipalities that reformed reached coverage levels higher by 4 percentage points than municipalities that did not reform. In the case of water supply service, however, the opposite effect occurred and municipalities that include private capital in service provision show a coverage increase lower than those that did not reform the provision. In this case, the estimated difference is 6 percentage points.

Results of reform effects on child mortality rate and on coverage increase lead to the conclusion that coverage expansion of water supply and sewerage services is an effective transfer mechanism of the reform effects on child mortality. However, absence of a positive reform impact on coverage behavior suggests the need to redesign the system of allocation of resources to the sector, in a way that said resources are actually used in infrastructure investments which allow to increase population access to public services.

Evidence found suggest that provision of water supply and sewerage services directly by local governments may yield better results than results obtained by specialized companies in terms of decreasing child mortality. It is advised then to focus sector policies on supporting and accompanying municipal providers.

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ANEXO: DEFINITION OF VARIABLES

Variable	Definición	Fuente
Cobertura acueducto	Porcentaje de viviendas con acceso a acueducto	DANE - Censo 1993 y Censo 2005, Cálculos propios
Cobertura alcantarillado	Porcentaje de viviendas con acceso a alcantarillado	DANE - Censo 1993 y Censo 2005, Cálculos propios
Porcentaje de viviendas con mas de 4 hogares	Porcentaje de viviendas en las cuales habitan más de 4 hogares	DANE - Censo 1993, Cálculos propios
Porcentaje poblacion con secundaria completa	Porcentaje de población que terminó la eduación secundaria	DANE - Censo 1993, Cálculos propios
NBI	Indice de Necesidades Básicas Insatisfechas	DANE
Tasa de ruralidad	Porcentaje habitantes del area rural del municipio	DANE - Censo 1993, Cálculos propios
Coeficiente de GINI	Distribución de la tierra según avaluo	DANE - Cálculos CEDE
Ingresos tributarios	Ingresos tributarios por habitante en pesos del 2000	DNP - Cálculos CEDE
Tasa de mortalidad infantil por causas externas	Porcentaje de defunciones de niños menores de 5 años por causas no externas (excluye las causas del capitulo 5 de la Lista 6/67 de la CIE-10), respecto al número de habitantes menores de 5 años en el municipio	DANE - Estadísticas Vitales, Cálculos propios
Tasa de mortalidad infantil por enfermedades infecciosas y transmisibles	Porcentaje de defunciones de niños menores de 5 años por las enfermedades contempladas en el capítulo 1 de la Lista 6/67 de la CIE-10, respecto al número de habitantes menores de 5 años en el municipio	DANE - Estadísticas Vitales, Cálculos propios
Participación	Porcentaje de participación electoral en las elecciones locales	Registraduría Nacional del Estado Civil, Cálculos CEDE
NEP	Número efectivo de partidos en las elecciones locales	Registraduría Nacional del Estado Civil, Cálculos CEDE
Afiliados_RS	Porcentaje de población afiliada al Régimen Subsidiado de salud	DNP - Cálculos CEDE
Población	Número de habitantes del municipio	DANE - Censo 1993 y Censo 2005, Cálculos propios

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Signed at Abbotsford, B.C., on November 10, 2008

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