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Does Society Win or Lose as a Result of Privatization? Provision of Public Services and Welfare of the Poor: The Case of Water Sector Privatization in Colombia

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Abstract[1]

This paper studies the effects of water sector privatizations on consumers' welfare in 46 municipalities in Colombia. First, the privatization process is described. Second, the paper evaluates the impact of privatization on access, price, and quality of water as well as health outcomes using differences-in-differences methodology with variation across time (before and after privatization) and between treatment and control groups (privatized and non-privatized municipalities) and controlling for household and municipality characteristics. The results show positive effects of privatization, in particular in urban areas. There are four main results: (i) Privatization in urban areas increases access, has positive effects on the quality measured as the need for treatment and the aspect of the water (e.g., presence of particles in the water), and improves health outcomes, as well as improves the frequency of the service for the lower quintiles. (ii) Privatization increases the price of water in the lower quintiles, although these effects may be the result of the joint implementation of privatization and the elimination of cross subsidies. (iii) In privatized municipalities with better governmental technical capacities there are positive effects on access, prices and quality. (iv) the positive effects of privatization in rural areas on the frequency of the service and on health outcomes are outweighed by negative impacts on access and prices. These results suggest that the benefits found in urban areas should be expanded to rural areas, and that the service should be more targeted toward the poorest.

[1] We would like to thank Felipe Castro and Carlos Ospino for their valuable research assistance. We are grateful for very useful comments from the coordinators of the project (Alberto Chong, Suzanne Duryea and Eliana La Ferrara), Juan Camilo Chaparro, and the participants in the IADB seminar where the first draft of this paper was presented. The views expressed here are those of the authors and are not necessarily shared by the World Bank or Fedesarrollo.

1. Introduction

Management of the water sector is difficult. On one hand, water is essential for life, and access to good quality water is necessary in order to improve standards of living of the population. Moreover, externalities, such as effects on health, compel the state to intervene. On the other hand, private participation is likely to improve the efficiency of the sector in the provision of service. These two contradictory concerns can be resolved through private participation and a regulatory scheme that assures access and quality of the service, especially for the poor. For that purpose, since the beginning of the 1990s Latin American countries have introduced various mechanisms of private participation (e.g., concessions, build operate and Transfer—BOT—schemes, joint ventures, capitalization, and leases, among others) accompanied by regulation schemes. Colombia is no exception; its water sector has undergone two structural reforms since the end of the 1980s. First, water services were decentralized and now municipal governments are responsible for the provision of the service. Second, the 1991 constitutional reform introduced the mechanisms for private participation in this and other sectors that were controlled by the state.

Privatizations have since then lost momentum and have even encountered significant political opposition. In 2002, according to Latinobarómetro, an annual survey in 17 Latin American countries, 61 percent of respondents[2] disagreed with the statement that privatizations have been beneficial to the country. In Colombia, 65 percent of the population disagrees with privatizations. However, the effect of water privatizations on welfare has not been fully studied. In fact, cross-country evidence in the region is inconclusive. On one hand, Clarke et al. (2004) show in their study for Argentina, Bolivia and Brazil that access improved in both privatized and non-privatized zones, suggesting that "Private Sector Participation, *per se*, may have not been responsible for these improvements" (Clarke, et al., 2004, p. 1). On the other hand, McKenzie and Mookherjee (2003) conclude in their study for Argentina, Bolivia, Mexico and Nicaragua that increased access at the bottom of the distribution outweighs the negative effect of increased prices. However, the effects on quality and on poverty are not conclusive.

In order to address this uncertainty, this paper studies the effects of water privatizations on consumer welfare in Colombia. In particular, we measure the impact on access, quality and prices of water as well as on health outcomes. In spite of the unpopularity of privatizations, our

[2] 16,788 persons responded to this statement. See Carrera et al. (2004).

main results suggest that privatizations have positive effects on welfare, especially in urban areas. In privatized urban municipalities, we find an improvement in access to water, and an increase in the quality of water, measured as the need for water treatment or as the aspect of water. The frequency of the service, another measure of quality, decreases in privatized urban areas, but it increases for the lower quintiles. We also find a positive impact on health outcomes as measured by the weight for height ratio of children. In addition, in the urban areas of municipalities with better government technical capacities we find positive effects on access, payment and quality. In rural areas the negative effect of privatization on prices and strong negative effects on access to water outweigh the positive impacts on the improved frequency of the service and on improved child health, even after controlling for migration to these areas.

As the results show, the low levels of support for privatizations reflected in surveys like Latinobarómetro can be explained through price effects. However, as we discuss below, privatization was undertaken simultaneously with the elimination of a cross-subsidy scheme, a factor that complicates explanation of changes in price. In addition, in terms of political economy the challenge is to expand the positive effects in urban areas to rural areas as well.

The paper is organized in five sections, including this introduction. In the second we present a review of the water sector privatization process in Colombia since the early 1990s. We additionally compare municipalities that privatized and those that did not in the evolution of key welfare variables related to the Colombian water sector (i.e., variables capturing access or coverage, prices, and consumption). In the third section we discuss the hypotheses and the econometric methodology used to test them. In the fourth section we analyze the data and present the results of our estimations. The fifth and final section presents the main conclusions.

2. Water Privatization

The rules of the game for private participation in the utility sector in Colombia were introduced in the 1991 constitutional reform. While Colombia began the privatization process relatively late in comparison to other countries in the region, the country caught up rapidly during the period of 1994-1997. Three factors help to explain this performance. First, until the mid-1990s, Colombia was the most stable economy in the region, with high and stable growth, stable inflation, and a relatively low fiscal deficit. As a result, there was no urgent need to adjust public finances. Second, political factors, especially the role of labor unions, impeded the privatization of

utilities. For example, the attempt to privatize the state-owned telecommunications company began in 1992 but was not completed achieved until 2004 due to labor union pressures. Third, since the beginning of the 1990s Colombia has decentralized the responsibility for most public utilities to sub-national governments, and consequently the central government's power to influence privatization has become weak and indirect.

The share of private participation in the water sector is low compared to private participation in other sectors (i.e., 2 percent of total private participation). However, as in other countries, private participation in this sector has limitations for a variety of reasons. First, until the end of the 1980s, the sector was a State monopoly with lower potential competence and high fixed costs. Second, externalities in this sector are more pronounced. The most important cited example is health, but there are others such as environmental, gender, and poverty externalities. These externalities compel the State not to leave the sector completely in hands of the private sector. In addition, the decentralization[3] of the sector could have affected private participation, as decentralization atomized the ownership of enterprises[4] and limited the capacity of the central government to influence the privatization process.[5] The central government can only intervene indirectly through financial and other incentives for sub-national governments. The most important incentives implemented in Colombia are the "Programa de Modernizacion Empresarial" (PME) and the "Programa de Privatizaciones y Concesiones en el Sector Agua," both designed in 1997. These programs give technical and financial assistance to municipalities to design private-public participation projects. Applying these incentives, the National Department of Planning and the Ministry of Economic Development implemented three pilot projects in medium cities:[6] Montería, Pasto and Bucaramanga (DNP, 1997).

Table 1 shows private participation in the sector in municipalities with a population greater than 100,000, and Table 2 lists small city projects implemented by PME up to 2003. Some of the projects presented in Table 1 were implemented before the design of the incentive programs (e.g., Barranquilla, Cartagena, Girardot, and Tunja). Others, like the Metroagua project

[3] The decentralization process began in Colombia in 1986 with the popular election of majors and was reinforced in the 1991 constitutional reform with the transfer of tax revenues and responsibilities.
[4] According to the Public Services Superintendency (2002), there are approximately 2,300 enterprises in the water and sanitation sector.
[5] Until the end of the 1980s, this sector was managed by the "Instituto de Fomento Municipal" (Insfopal), a central government agency that was closed in 1986.
[6] Medium cities are cities with population greater than 100,000 and smaller than 1,000,000.

in Santa Marta, were implemented later on but without the participation of the central government.

Two additional points are worth mentioning. First, given the sector's strong externalities, the government is in most cases responsible for financing long-term investment to assure coverage. Second, water and sanitation supply in the three largest Colombian cities—Bogota, Medellin and Cali—are still managed by public enterprises.

Box 1. Private Participation in Barranquilla and Cartagena

Barranquilla (20-year lease)

Since 1960, the Municipal Public Enterprises of Barranquilla (EPM) managed water and sanitation services. Political manipulation of the EPM was widespread, and the state-owned firm reached technical bankruptcy by the early 1990s. At the end of 1990, water coverage was only 60 percent, and operating expenditures consistently exceeded revenues. In 1991, due to deficient service and poor management, the central government supported a process of institutional transformation leading to the liquidation of the EPM and the creation of the Sociedad de Acueducto, Alcantarillado y Aseo de Barranquilla, S.A. (Triple A). The District of Barranquilla retained 89 percent of the shares in the newly created firm and sold 11 percent to the local private sector. The private sector was involved through the creation of a mixed enterprise responsible for administering the assets of the system owned by the municipality, while the city was responsible for investment projects. In 1995, the municipality reduced its ownership to 50 percent, reduced local private sector participation to 6.7 percent, and sold 43.3 percent of the ownership to Aguas de Barcelona.

Cartagena (20-year lease)

In 1995, the municipality of Cartagena signed a lease contract with Aguas de Cartagena, a firm partially owned by Aguas de Barcelona (46 percent) and by other private investors (4 percent); the municipal government kept a 50 percent share. The contract was negotiated directly with Aguas de Barcelona and was not put up for bidding. The new company had control of a major sector investment program, which was financed with a municipal loan from the World Bank and the Inter-American Development Bank. In addition to its participation as a shareholder, Aguas de Barcelona also signed a management contract, for which it received a fixed share of revenues. The introduction of private sector participation improved the performance of the sector.

Sources: Clarke et al. (2004) and Nickson (2001).

In addition to the introduction of private participation in State Owned Enterprises (SOEs) looking for economic efficiency, the 1991 constitutional reform introduced a regulatory framework to avoid perverse distributional effects and guarantee a fair competition. As competition should benefit consumers, the regulatory framework intervenes through price mechanisms. These mechanisms include prohibiting prices lower than operational costs so that competitive enterprises are not driven out of business by other companies willing to take temporary losses in order to increase their market share; a second mechanism is the use of price caps to prevent excessive rent-seeking by utilities (Prasad, 2005). The regulatory framework is also important for the water and sanitation sector since the increased openness of the economy introduced competition into all tradable markets, and the monopoly problem was confined to the public services that are often considered natural monopolies, such as energy distribution, water and sanitation services, and telecommunications.

Three laws rule these objectives: the Privatization Law (Law 226 of 1995), the public services law (Law 142 of 1994) and the electricity law (Law 143 of 1994). The Privatization Law assures the participation of workers in the privatization process, or the democratization of property. For this purpose any SOE should be sold in two steps. In the first, the SOE is offered to its workers under special conditions in terms of length and loans, and with a fixed price. In the second, the SOE is offered to the public in general, with competitive price mechanisms. In general, the base price of the first step is lower than that in the second step (DNP, 1997).

The law of public services designed the regulatory framework. Among their most important characteristics, this law requires the incorporation of public service providers as "Sociedades por acciones" (ESP), which aims to isolate firm management from political intervention. Two other important features are related to the tariff regime. First, the law intended to eliminate implicit subsidies, which are generally designed with political motives; at present there exists an explicit scheme of cross-subsidies to finance the lower income strata. However, to assure financial viability of the providers, making the tariff reflect their costs, the law set forth a transitional period in which this cross-subsidies scheme would be eliminated. Due to political pressure, the official deadline for closing the tariff gap between price and costs was extended until the end of 2005, although the cross-subsidy scheme nonetheless remains present in practice at the time of writing. In addition, given the intrinsic differences between the water and electricity sectors, the electricity law followed the general framework of the public services law

and developed specific aspects of the links between generation, transmission and distribution of electricity with a long-run plan for expansion.

The public services law additionally defined the institutional organization of regulation. The regulatory scheme has a national scope, regulates both public and private enterprises, and is separated into two different agencies: a commission that is in charge of the policies of the sector, and a superintendency that is in charge of control. The three regulatory commissions for public services are the Energy and Gas Regulatory Commission (CREG), the Water and Sanitation Commission (CRA), and the Telecommunications Regulatory Commission (CRT). These commissions are responsible for planning the evolution of their sectors and guaranteeing the quality and coverage of public services. The "Superintendencia de Servicios Públicos" controls the performance of the public services sector and protects consumers' welfare.

After these reforms, the stylized facts presented below show that coverage and prices in the sector increased in both municipalities that privatized and municipalities that did not.[7] Water and sewerage coverage, measured by the number of users and by the number of households, increased in both privatized and non-privatized municipalities (Table 3). In 2001, water coverage exceeded 90 percent in non-privatized municipalities, and with the exception of Monteria, Santa Marta, Sincelejo and Florencia, access is also above 90 percent in privatized municipalities. Compared to these numbers, sanitation coverage is lower in both privatized and non-privatized municipalities.

With respect to prices, there exists a cross price-subsidies scheme from the higher strata (5 and 6) to the lower strata (1,2 and 3). However, following the transition toward eliminating the scheme defined by the law, tariffs in lower-income sectors have increased for municipalities both with and without private participation in the sector. Figures 1 to 4 show the change in tariffs per stratum between 2001 and 2004 for water and sewerage sectors in the four largest cities (Bogota, Medellin, Cali and Barranquilla). In both sectors there has been an effort to reduce subsidies for the lowest strata, although tariffs in higher-income strata have also increased for sewerage.

Cross-subsidies are still high, and the increase in tariffs for the poor to close the gap and ensure financial viability of the sector in the long run is important. Table 4 shows that on average

[7] The stylized facts are based on DNP data, and on data collected by at the Regulatory Commission and the Superintendency of Public Services.

the tariff for the poor is between 46 and 75 percent of the tariff of the higher strata, both for privatized and non-privatized firms (on average between 60 and 65 percent, respectively). To close the gap between tariffs and costs, and to avoid the distortions generated by cross-subsidies, low-income households' tariff should increase between 35 and 40 percent in real terms, while for higher income households the tariff should be reduced by approximately 13 percent.

As a result, water consumption has decreased. Table 5 shows the reduction in water consumption between 1997 and 2001 in the following main cities: Bogota, Medellin, Cali, Barranquilla, Bucaramanga and Cartagena. As described before, in the former three cities water and sanitary services are provided by the public sector, while in the latter three they have been privatized. Reduction in consumption has been higher for low-income households, except in Barranquilla, and, in a lesser degree, Medellin. However, the tendency is similar in cities both with and without private participation. In sum, in the water and sanitation sector there is a trend of increasing coverage, higher prices and lower consumption, regardless of whether a municipalities' services are public or privatized.

Box 2. Consumer Satisfaction Survey

The Superintendency of Public Services conducted a survey on consumer satisfaction after 10 years of water and sanitary sector reform[8] in five principal Colombian cities: Bogota, Medellin, Cali, Barranquilla and Bucaramanga. The table below show the responses of questions about quality, price, and coverage. The survey reports that, in general, coverage and quality have increased in cities both with and without private participation,[9] and for all strata, but prices have increased as well. An important result is for Barranquilla, with the highest positive responses in terms of quality and prices and the second-highest satisfaction with coverage.

[8] Data collected in June 2004; sample size 2,200 individuals distributed by income level: low (strata 1 and 2, 42 percent), medium (strata 3 and 4, 51 percent) and high (strata 5 and 6 and nonresidential).

[9] The water providers of Bogota, Medellin and Cali are public, while Barranquilla and Bucaramanga's providers are private.

		Consumers' satisfaction:		
		Tariffs[1]	Coverage[2]	Quality3
		(Very expensive + expensive)	Increased	Improved
		By City		
Water	Barranquilla	44	62	80
	Bucaramanga	68	41	55
	Bogota	86	47	36
	Cali	78	41	36
	Medellin	61	65	59
Sewerage	Barranquilla	56	61	72
	Bucaramanga	73	40	51
	Bogota	87	42	32
	Cali	75	39	30
	Medellin	61	63	59
		By Stratum[4]		
Water	Low	63	59	
	Middle	72	45	
	High	74	46	
Sewerage	Low	66	56	
	Middle	74	43	
	High	75	47	

Notes:

[1] Question: Keeping in mind the the quality of the service that you are receiving today, would you say the service is

[2] Question: In the last 10 years have you seen that the service coverage in your neighborhood has

[3] Question: As compared to the quality of the utilities that you received 10 years ago, would you say that the quality

[4] Lower income correspond to strata 1 and 2, middle income to strata 3 and 4, and high income to strata 5, 6 and non residential.

Source: SSPD (2005b)

3. Hypotheses and Econometric Strategy

The aggregate data from the previous section showed a similar pattern in prices and access for both privatized and non-privatized municipalities. However, this is a restricted, partial analysis, since its source of variation is at the municipal level and not from micro household data. In this section we present the econometric strategy for studying the impacts of privatizations in the water and sanitation sector on access, payment, quality, and health, using two sources of micro data.

In general, we will estimate a functional form of the following equation:

$$Y_{i,j,t} = f(X_{i,t}, X_{j,t}, D, \varepsilon_{i,j,t}) \quad (1)$$

where the impact variable (denoted as $Y_{i,j,t}$) may be access to water, prices, quality of the service, or health outcomes for individual *i* living in municipality *j* at time *t*; *D* is a dichotomous

variable equal to 1 for individuals in municipalities in which privatization took place and equal to 0 for the comparison group of individuals (i.e., individuals in municipalities without privatization); $X_{i,t}$ is a vector that includes control variables of the individuals and $X_{j,t}$ a vector of municipal characteristics that affect the impact variable; and finally $\varepsilon_{i,j,t}$ captures the unobservable characteristics of the individuals. The subscript *t* denotes time variation (i.e., 1997, before privatization, and 2003, after privatization).

We estimate a family in a difference-in-difference model under one identification assumption. We exploit variation at the household and municipality level, time variation (i.e., before and after privatization); and "treatment" variation (i.e., privatized and non-privatized municipality).

The specification of Equation (1) to be estimated is the following:

$$Y_{i,j,t} = \beta_0 + \beta_1(t * D) + \beta_2 D + \beta_3 t + \mathrm{B}_4 X_{i,t} + \mathrm{B}_4 X_{j,t} + \varepsilon_{i,j,t} \qquad (2a)$$

and we present four estimations of the same equation: first, without controlling for the indices of technical capacity for the municipalities, but controlling for fixed effects at municipalities; second, controlling for the indices of technical capacity (invariant over time); second, estimating for urban and rural areas separately, and finally, including the possibility of differential effects across quintiles of income. The last variation is estimated using the following equation,

$$Y_{i,j,t} = \beta_0 + \beta_1(t * D) + \beta_2 D + \beta_3 t + \mathrm{B}_4 X_{i,t} + \mathrm{B}_4 X_{j,t} + \beta_5 Q_{i,t} + \sum_k \beta_{6,k}(Q_{i,t,k} * D * t) + \varepsilon_{i,j,t} \quad (2b)$$

where Q represents the quintiles. The impact of privatization is given by the difference-in-difference estimator (DD):

$$DD = \beta_1 D + \beta_2[(X^T_{t=1} - X^T_{t=0}) - (X^C_{t=1} - X^C_{t=0})] + [(\varepsilon^T_{t=1} - \varepsilon^T_{t=0}) - (\varepsilon^C_{t=1} - \varepsilon^C_{t=0})] \quad (3)$$

which gives the effect of the treatment ($\beta_1 D$).

Endogeneity problems in estimations of Equations (2a) and (2b)[10] occur when there are characteristics that are not observable by the researcher but influence the decision to carry out the privatization. For instance, suppose that privatization occurs in municipalities in which technical capacity is higher than in the rest of the country, presumably because the human capital

[10] For a general discussion of endogeneity problems and econometric strategies, see Heckman et al. (1999).

of that municipality is higher. Also, suppose that the dependent variable $Y_{i,j,t}$ is infant mortality, which presumably depends on the quality of the water but also on the "quality" of the household. Since a "better" quality of household and higher technical capacity are difficult to quantify, these unobservable characteristics will be included in the term $\varepsilon_{i,j,t}$ in Equation (2). At the same time, individuals in these municipalities may have a greater probability of living in a municipality in which privatization occurred and, therefore $E(D,\varepsilon_{i,j,t}) \neq 0$, which makes β_1 a biased estimate.

To tackle the problem of endogeneity, we use the following identification assumption. The changes in the unobservable characteristics are equal across groups (treatment and control) or—a stronger assumption—the unobservable characteristics are equal for the treatment and control groups at each period of time. Hence, to estimate the true impact of privatization, we will make use of the following identification assumption: the unobservable characteristics are time invariant.

In order to see why this makes the DD unbiased, assume that $\varepsilon_{i,j,t}$ presents the structure $\varepsilon_{i,j,t} = \eta_i + \mu_{i,j,t}$, where η_i is the unobservable set of characteristics that are time invariant and $\mu_{i,j,t}$ is a pure random component. In this case, $(\varepsilon^i_{t=1} - \varepsilon^i_{t=0}) = (\eta_i - \eta_i) - (\mu^i_{t=1} - \mu^i_{t=0}) = (\mu^i_{t=1} - \mu^i_{t=0})$ is random and not related to the fact that the person is under the effects of privatization, and therefore, $\tilde{DD} = \beta_1$.

4. Data and Results

4.1 Data

For the dependent ($Y_{i,j,t}$) variables we use the information from the Encuesta de Calidad de Vida (ECV) for the years 1997 and 2003. These household surveys have an extended questionnaire, with chapters that include information on household education, health, income, consumption, and shocks, as well as the characteristics of the household's dwelling unit. We complement these data with health variables, related specifically to diseases caused by poorly treated water, from the 1995 and 2005 Demographic and Health Surveys (DHS).[11]

[11] These surveys are available at www.measuredhs.com.

It would be ideal to use a panel of *households* to compare outcomes through time, but unfortunately the available data do not allow us to do so. Instead, we have built a panel of *municipalities* for which we have information in both years. Table 6 presents the municipalities for which there are observations for both years in the ECV survey (1997 and 2003), and for the two health variables, diarrhea and weight for height, from the 1995 and 2005 DHS. Based on the privatization process discussed above, we identify municipalities where water privatization took place and we form an unbalance panel dataset at the municipality level. There are a total of 46 municipalities with observations in both years for the ECV, and 36 more (for a total of 82) municipalities with health variables coming from the DHS for Colombia.

Water privatizations presumably have an impact on the coverage, price, and quality of water, as well as on the incidence of health problems related to poor quality water. We measure coverage as a 0/1 dummy capturing access to water (e.g., connected to water services or not), price as the monthly payments made by the household (as percentage of total income[12]) for water consumption, quality as the need for treatment for consumption, the frequency of service (continuity of services through the week) and the aspect (if it is turbid, or with particles) of the service, and for health variables we include children with diarrhea in the last two weeks (a 0/1 dummy) and a measure of weight for height. We expect that one of the most important impacts of provision of water is on health indicators, as the literature shows (for instance, Galiani, Gertler, and Schargrodsky, 2005).

Table 7 presents the means of the dependent measures for privatized and non-privatized municipalities in 1997 and 2003. Access to water is relatively high, with 94 percent and 96 percent of households, respectively, having water service. Such high coverage may imply that marginal increments are quite difficult to achieve. Coverage does, however, vary between urban and rural areas, and to this end we present both the data and the estimations allowing for heterogeneity responses by urban andrural areas. Coverage of service increases with time, with no statistical differences between privatized and non-privatized municipalities. Expenditure on water services, as a percentage of the total income of the household, increases through time in both privatized and non-privatized municipalities. In terms of the quality of the service, the indicators show overall improvements between 1997 and 2003 in both types of municipalities.

[12] This dependent variable was calculated also as monthly payments in 2003 pesos. The results do not change significantly.

Households do not report a difference in the need to treat piped water. However, with respect to the frequency and the aspect of water, privatized municipalities present worse outcomes than non-privatized ones. Regarding health outcomes from the ECV, in both privatized and non-privatized municipalities we observe a general improvement between 1997 and 2003. Similarly, the diarrhea and height for weight indicators from the DHS present improvements between 1995 and 2005. There are no statistical differences in these indicators for privatized and non-privatized municipalities over time.

For control variables we use two types, one for household characteristics ($X_{i,t}$) and one for municipal characteristics ($X_{j,t}$). The sources for the first type of controls are the Encuesta de Calidad de Vida or the DHS, depending on the impact estimated.[13] The sources for the second type of controls are the National Department of Planning (DNP) and the National Department of Statistics (DANE).

At the household level we include measures of housing characteristics, human capital and income. Housing characteristics include the following measures: whether the dwelling unit is in a rural or urban area, the type of ownership, and indices capturing the infrastructure of the house and the assets of the house. The infrastructure index includes the type of floor (0 if is inadequate, 0.5 if it is fairly adequate and 1 otherwise), a natural risk factor (0 if the household faces a natural risk, 1 if not) and number of individuals per bedroom (0 if there is 2 or more people per bedroom, 1 otherwise). The asset index includes the existence of a washing machine, refrigerator, blender, oven, motorcycle, and car. Both indexes go from 0 to 1, where 1 indicates the highest quality of infrastructure or highest possible asset accumulation and 0 the lowest. Human capital variables include years of education (of all adults and of the head of the household) and some demographic variables (such as the size of the household, marital status and gender of the head, among others). Finally, income variables include income of the household from all sources (in constant pesos of 2003), total consumption (in constant pesos of 2003), and employment, measured via occupancy (yes or no) of the head or all the adults in the household.

Housing characteristics show the following trend. The percentage of rural households in the sample is between 11.9 percent and 8.5 percent for the 1997 and 2003 samples, respectively.

[13] From the DHS we have the same type of household controls, except a measure of income. As shown below, the unavailability of these data prevented us to estimate the effects of privatizations on health by quintiles.

The sample of 2003 tends to be more urban induced by over-sampling of Bogota in 2003, and there are no differences in the percentage of households in rural areas for the privatized and non-privatized municipalities. By 2003 around 87 percent of households owned a house (including houses that were totally paid for and houses whose owners were still making payments). Household ownership increased between 1997 and 2003, at a faster rate for the non-privatized municipalities. On average, the infrastructure index presented a small reduction over time. A typical house presents 60 percent of adequate infrastructure, and the index decreased slightly more for the privatized municipalities than for the non-privatized ones. In terms of the asset index, the typical household had in both years around 50 percent of the assets included in the index. There are no differences across time or across types of municipalities.

Human capital characteristics are not different between privatized and non-privatized municipalities, with the exception of the age of the head of household, which is younger in privatized municipalities. The sample additionally shows improvement of indicators improvement for number of households and education, and there is some trend towards more migration in 2003 than in 1997.

Average income falls dramatically between 1997 and 2003. In 1999 the country suffered a severe depression, and the recovery was very slow. This decline was especially pronounced for urban as opposed to rural areas, and for non-privatized than privatized municipalities; the latter result is driven by Bogota. In terms of employment, there is no difference in the employment rate of household heads, which is around 74 percent. In general, we do not find systematic differences between privatized and non-privatized municipalities regarding the "exogenous" variables. Some exceptions are per-capita income and homeownership. Despite these cases, there was not a clear direction of the differences.

The second set of control variables are those that vary at the municipal level. The first set of municipal variables is fixed and time-invariant, and there are no differences between privatized and non-privatized in any of the municipal variables. In particular, there are no differences between the two groups in terms of surface area, distance to the state capital and altitude. Similarly, there are no differences in terms of the level of Unmet Basic Needs in 1993, and both types of municipalities had the same starting point in terms of income.

The similarity in exogenous variables at both household and municipal level between privatized and non-privatized localities is critical in order to isolate the true effects of the

privatizations from other, exogenous differences in characteristics between privatized and non-privatized municipalities, thus ensuring that $(X^{T}_{t=1} - X^{T}_{t=0}) = (X^{C}_{t=1} - X^{C}_{t=0})$ will reduce the source of bias.

The second set of municipal variables includes fiscal indicators that can be divided in three groups: indicators of technical capacity, municipal variables exogenous to the privatization process, and fiscal variables that may be endogenous to the privatization process. Indicators proxy to technical capacity are an important component of the effect of privatizations on welfare in the sense that there is a branch of the literature that proposes the hypothesis that privatization "works" in municipalities that have enough technical capacity to take advantage of the process. However, another type of causality may emerge. Indeed, technically sound municipalities that have been successful in running public services are less likely to privatize compared to municipalities with lower technical capacity that are unsuccessful in the provision of services. We develop the argument in the discussion of the results.

In choosing the proxies for technical capacity we include income from local taxes as percentages of total municipal revenues (Local taxes revenues / Total revenues) and savings capacity ((Current Income-Current Expenditure) / Current Income), borrowing several ideas from the public finance literature (for the general case, see Bird and Smart, 2002, and Fiszbein, 1997; and Chaparro, Smart and Zapata, 2006, for the case of Colombia). On one hand, local income taxes depend on three variables: the tax base, the level of the tax and the technical capacity of the municipality. Once we normalize local income dividing by total income, two municipalities that have an equal tax base and tax rate will have differences in the ratio thanks to the collection technical capacity. In turn, the technical capacity will depend on the human capital and the administrative capacity of the locality (Fiszbein, 1997). One clear example of this proxy of technical capacity is that local revenues depend, for instance, on the ability of the municipality to create a good measure of the size of property within the municipality. On the other hand, savings capacity is a critical variable for fiscal purposes. Local investment depends on the amount of transfers, debt and savings capacity. Usually, more advance and sound municipalities will use a bigger proportion of savings capacity to finance its own investment. For this reason, savings capacity can serve as well as a measure of technical capacity of the municipality. In short, municipalities with higher administrative and technical capacity are able to increase their local tax base, and municipalities with greater administrative capacity are able to accumulate

more current savings. We include these proxies in order to investigate the hypothesis of differential impacts of privatization depending on technical and administrate capacity, and taking into account that the regulatory framework applies to all firms, public and private, due to its centralization.

For the group of fiscal variables exogenous to the privatization process we include transfers from central government revenues. These transfers are determined by a set of rules outside municipalities' decision-making power and therefore in the short run exogenous for the municipality. Finally, for the group of fiscal variables endogenous to the privatization process we include current income earmarked for administrative expenditures and investment expenditures as percentage of total expenditure. Clearly, privatization can ease the budget constraint and induce a reallocation of expenditure. Nevertheless, these two variables were not used as controls in the estimation, since they could generate endogeneity problems.

In general terms, there exists an apparent upward time trend in revenues from local taxes for non-privatized municipalities (Figure 1, Appendix 1). For privatized municipalities, there is a drastic drop between 1994 and 1995, and stability since then. Despite the apparent difference between privatized and non-privatized municipalities, there is no significant difference at a 90 percent confidence interval. Current savings present a clear upward trend, from 1994 to 2004, for both privatized and non-privatized municipalities (Figure 2, Appendix 1) with no significant difference between the privatized and non-privatized municipalities. In sum, there is no evidence of differences in technical capacity between one group and the other.

Transfers to municipalities do not differ either between privatized and non-privatized (Figure 3, Appendix 1). Transfers have been increasing steadily since 1994. Current income intended for current operational present a clear negative slope since 1994, with no significant difference between privatized and non-privatized municipalities (Figure 4, Appendix 1). Finally, revenues used for investment have been increasing since 1994 for both types of localities, again with no statistical difference across both types of localities (Figure 5, Appendix 1).

4.2 Results

Tables 8 to 12 present the results of the estimations of equations (2a) and (2b). For all the impacts the tables report the coefficients for the dummy that capture time changes (denoted by Time(t)), for the dummy that captures if the municipality is privatized or not (Private(P)), and for

the impact (*P*t*, which correspond to the DD estimator). All regressions include household and municipal controls, and we report regressions with and without variables that control for technical municipal capacity. The tables show also models in which we allow heterogeneity of treatment across quintiles of income, and for urban-rural sub-samples.

Briefly, the rationale fore including these four types of regressions (without controlling for technical capacity, controlling for technical capacity, quintile heterogeneity and urban/rural heterogeneity) is the following. First, controlling (or not) for technical capacity is important in light of the privatization literature emphasizing that privatization that privatization is more successful in municipalities with higher technical capacity. Second, allowing for quintile heterogeneity is important in order to determine the effects of privatization on households at the left of the income distribution. Finally, allowing for urban/rural differences is important because, as shown above, average levels of connection to water are very high in Colombia. As it turns out, the effects of privatization are *greater* in urban than rural areas; privatization apparently works in high-density areas that probably had infrastructure in place before privatization.

For access, there is no evidence of positive impact of privatization when the model does not include municipalities' technical capacity. The results do not show statistical differences between privatized and non-privatized localities, even after controlling for technical capacity. In addition, there are no significant differences in the effects of privatization on access across income quintiles. However, when we estimate urban and rural sub-samples, we find that coverage increased in privatized urban areas by around 2.4 percentage points. This effect disappears when we include municipal technical capacity as a control, suggesting that municipalities with technical capacity can somehow "compete" with private companies. An example is the city of Medellin, where the Medellin Public Enterprise (EPM for its acronym in Spanish) is one of the most efficient public enterprises. However, on the other hand, we find a strong negative effect on access in rural areas (Table 8).

On average, we do not observe any effects of privatization on prices. However, when we allow for heterogeneous responses from different quintiles of income, the data show higher prices increases for lower quintiles. Two reasons explain this result. First, due to the elimination of cross-subsidies in the water sector, quintiles 1 and 2 spend more of their total income for this utility, while the fourth quintile pays less. The effect is important. Lower quintiles pay an additional 7 to 11 percent in relation to their income, while for the fourth quintile the share of

income used to pay for water declined by 10 percent. Second, households in rural areas that privatized spend a higher amount of their income on water and sewerage, an estimated 3.2 percent of their income. This effect disappears, however, when we control for technical capacity (Table 9).

With respect to quality, households in localities that privatized have to treat less the water than in the non-privatized ones, and in particular households in urban privatized areas, independently of the technical capacity of the municipality (Table 10, Panel A). When the quality of water is measured as the frequency of the service, it is higher in non-privatized urban municipalities, although the second quintile presents an improvement in the frequency of the service compared to the fourth and fifth quintiles. Also, in rural privatized areas the frequency of the service is higher by a large percentage (i.e., around 20 percentage points higher; see Table 10, Panel B). The last quality of service variable is the subjective perception of the household with respect to the aspect of water.[14] In this case, for the whole sample water has better aspect in privatized areas, although the effect disappears when we control for technical capacity. However, the effect is positive in urban privatized areas (Table 10, Panel C).

Another way to see the influence of municipal technical capacity is to estimate the effect of this variable in privatized municipalities (i.e., the interaction between technical capacity and the privatization dummy; see Table 11). These estimations show that the effects of privatizations in municipalities with better technical capacity are positive on access, prices and quality (measured as frequency of service). These results suggest that better technical capacity might result in better control (i.e., government regulation).

With respect to health, we do not find effects of privatization on diarrhea in general.[15] However, we find that in rural areas that privatized the effect of privatization is a reduction of around 11 percentage points in the number of children with diarrhea. Although the effect is reversed when we control for technical capacity, the estimation losses degrees of freedom due to data availability[16] (Table 12, Panel A). Finally, with respect to the measure of weight for height, the effect of privatizations is also positive and significant when we include technical capacity as

[14] For this measure the ECV has data only for 2003.

[15] Given that the DHS survey does not include questions about income, the estimations by quintiles are not included in this and the next table.

[16] Notice, however, that when we include technical capacity of the municipalities as control, the number of observations decreases significantly. This is due to the fact that, as stated above, the source of the dependent variable (DHS Survey) does include additional municipalities, with fewer habitants interviewed, and there is no data availability of measures of technical capacity for these new municipalities.

control: municipalities that privatized has a measure of weight and height of the children higher compared to the median than municipalities that did not privatized, and, in particular, urban areas. This result of variation over time is more important since, as showed in the description of the variables, in privatized municipalities the measure of weight for height is lower than the median and also compared to non-privatized municipalities (Table 12, Panel B).

5. Conclusions and Policy Recommendations

In sum, we find positive effects of privatizations. Access increased in privatized urban areas; water in privatized areas needs less treatment for use; the frequency of service in privatized areas is lower, but higher for the lower quintiles; the incidence of diarrhea in children in rural privatized areas is lower; and the measure of weight for height is higher in privatized municipalities. In addition, municipal technical capacity is important in generating these positive effects, potentially through better regulation. The negative effect related to payment seems to be more related to the elimination of cross-subsidies between the higher and the lower quintiles. Finally, the positive effects on health and quality in rural areas are outweighed by negative effects on prices and access.

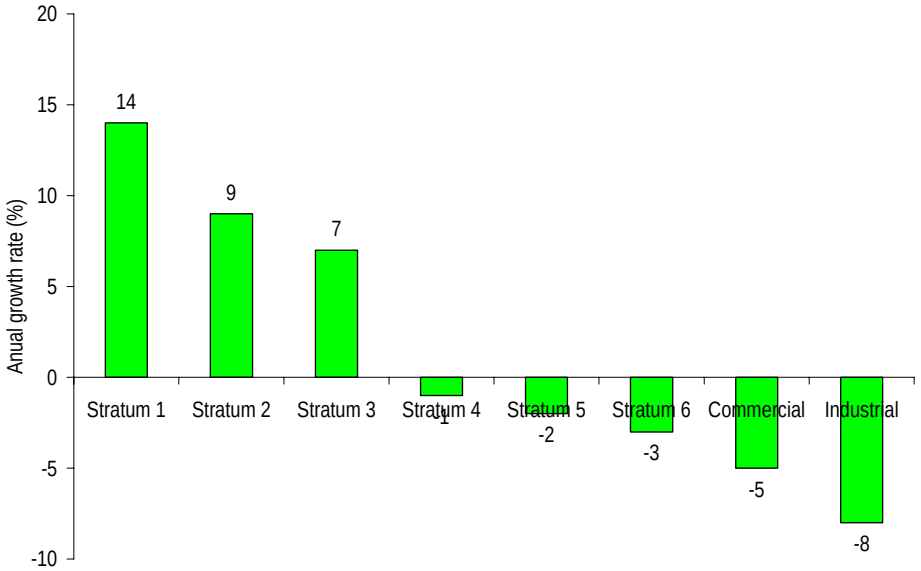
The results of this paper suggest several points for policy implementation. In general, we found that the effects of privatization are not homogenous across income and across areas, and heterogeneity on impact has several implications. From the point of view of the political economy of the process, it is important to realize that the effects are not homogenous across all households; it may therefore be useful to have in place targeted policies to mitigate negative effects. While this paper finds overall positive outcomes from privatization, the unpopularity of privatization stems from other sources. These may include localized effects, mainly in the price system.

Privatization is apparently working better in urban than rural areas. These effects are quite interesting, since it is believed that reaching the marginal house is more costly when the provision of the service is already high. On the contrary, and despite higher levels of connectivity in urban areas, privatization is working in dense cities. The challenge is to expand the benefits to the rural areas, and incentives to increase rural access may need to be generated through regulation.

It should additionally be noted that there are some cross-effects of privatization for low-income households. There are some positive effects on quality of the service and, in general, health outcomes that presumably affect more low-income families. In contrast, the price of service has been increasing more for low quintiles in privatized locations, and it appears likely that the increment in prices reflects the simultaneity of privatization and elimination of cross-subsidies. Despite the economic rationality of dismantling the subsidy systems, so that prices more accurately reflect the marginal cost of providing service, it may be preferable to improve the focus of cross-subsidies rather than eliminate them altogether. For example, Gómez-Lobo and Contreras (2003) discuss the differences between a means-tested system, such as Chile's, and Colombia's geographical system, concluding that targeting by a means-tested instrument results in better focalization.

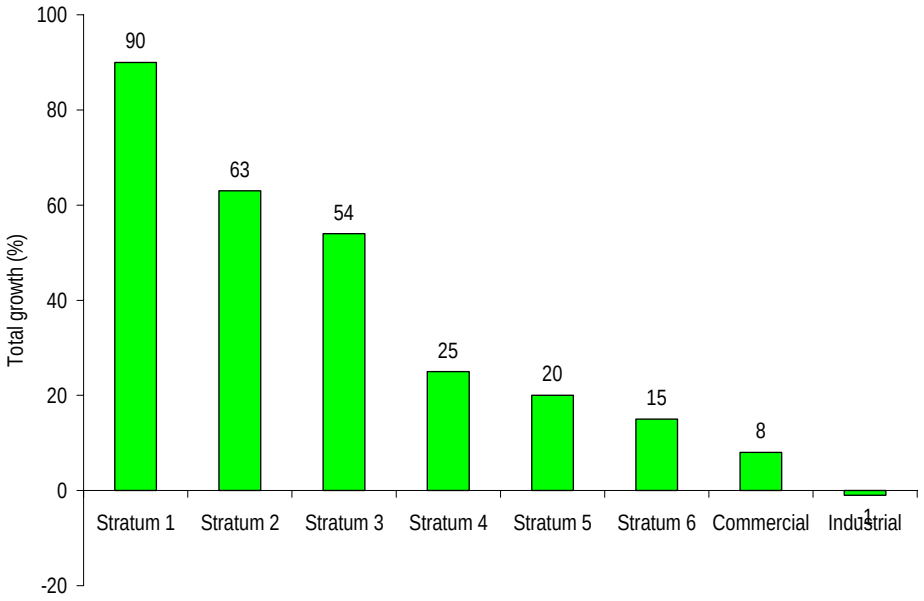
In terms of regulation, one of the main area where regulation should focus is on quality measures of the service such as the frequency of service, water quality in terms of treatment, and the aspect of water. Second, regulation should generate incentives to increase access in rural areas.

Figures and Tables



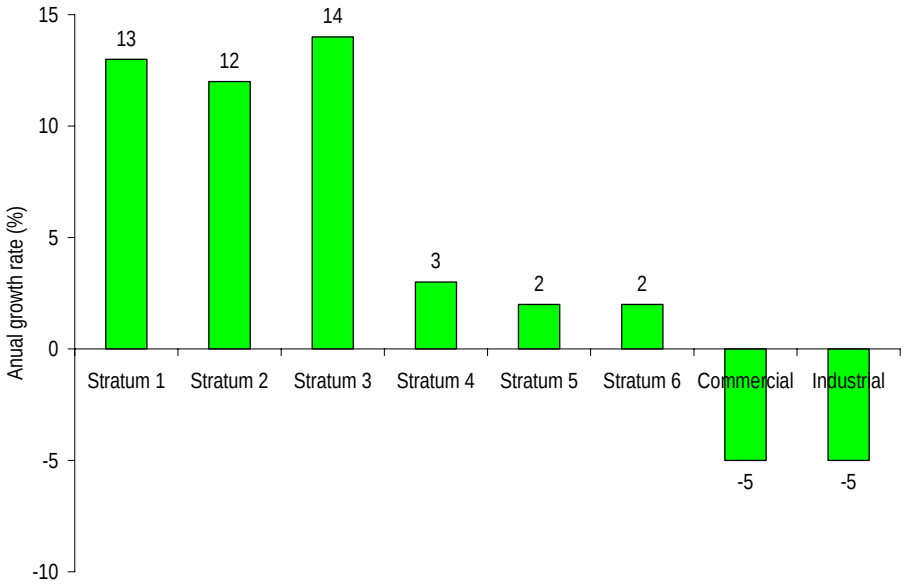
Source: SSPD (2005).

Figure 1. Four Largest Cities Water Tariff Annual Growth (2001-2002)



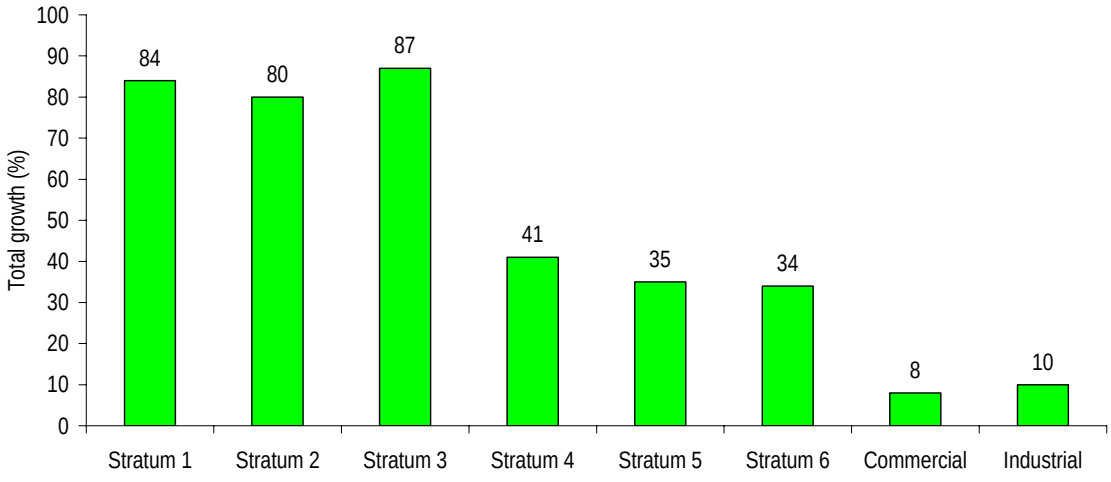
Source: SSPD (2005).

Figure 2. Four Largest Cities Water Total Increase in Tariffs (2001-2004)



Source: SSPD (2005).

Figure 3. Four Largest Cities Sewerage Tariff Annual Growth (2001-2004)



Source: SSPD (2005).

Figure 4. Four Largest Cities Sewerage Total Increase in Tariffs (2001-2004)

Table 1. Enterprises with Private Participation that Attend Municipalities with Population Greater than 100,000

Enterprise	Municipality	Private participation >50%	>50%, <10%	>10%	%	Year of privatization	Type of Contract	Partner
Triple A*	Baranquilla	x			80	1991	Concession	Aguas de Barcelona
Acuacar*	Cartagena		x		45	1995	Concession	
CAMB-CDMB*	Bucaramanga			x	5		Joint venture	Local
Metroagua SA	Santa Marta	x			65	1996	Concession	Aguas de Barcelona
Aguas de Manizales	Manizales			x	1		Joint venture	Local
Acuaviva	Palmira	x			60		Concession	Suez
Proactiva	Monteria	x			100	2000	Concession	Proactiva
Aap	Popayan			x			Joint venture	
Conhydra	Buenaventura	x				2002		
Centro agua	Tulua	x						
Acuagyr	Girardot	x			70		Concession	Suez
Servaf	Florencia	x			51		Joint venture	Local
Aguas de Peninsula	Maicao	x				2001		
Sera q.a.	Tunja	x			100	1996	Concession	Proactiva
Aguas de Guajira	Rioacha	x				2000		
Sincelejo	Sincelejo					2002		
Soledad	Soledad					2002		

Notes: * serves cities with population greater than 600.000. The rest serves cities with population between 100.000 and 600.000
Source: Authors calculations from CRA (2002), DNP (2005), and Fernandez (2004).

Table 2. Projects with Private Participation Implemented by PME

Department	Municipalities	Population	Initial date of operation
Atlantico	Sabanagrande y Santo Tomas (Asoasa)	44,000	August 2002
Atlantico	Ponedera	9,100	August 2002
Sucre	Sincelejo, Corozal	2,800,500	December 2002
Sucre	San Marcos	32,750	August 2002
Choco	Itsmina	13,500	October 2001
Choco	Trado	9,100	October 2001
Guajira	Barrancas, Distraccion, El Molino, Villanueva (Asoaguas)	42,700	June 2002
Cauca	Guapi	14,000	January 2002
Bolivar	San Juan Nepomuceno	27,000	December 2001
Huila	Nataga	1,800	April 2001
Magdalena	El Banco	51,700	February 2003
Meta	Cumaral	9,200	January 2002
Narino	El Charco	5,300	January 2002
Vichada	Puerto Carreno	7,500	January 2002

Souce: Fernandez (2004).

Table 3. Coverage of Water and Sewerage Systems

Panel A: Municipalities with Private Participation

		Number of users				Coverage (%)						Annual increase 1998-2001			
		Water		Sanitation		Water			Sanitation			Water		Sanitation	
Enterprise	Municipality	1998	2001	1998	2001	1990	1998	2001	1990	1998	2001	Users	Coverage	Users	Coverage
Triple A	Baranquilla*	226918	253116	175339	209778		89	94		76	80	3,7	1,7	6,2	1,7
Acuacar	Cartagena*	100571	137749	86778	110396		79	94		68	75	11,1	5,9	8,4	3,5
CAMB-CDMB	Bucaramanga*	161771	171365	160465	169606	84	99	99		99	99	1,9	0	1,9	-0,1
Metroagua SA	Santa Marta		61833		51092			85			70				
Aguas de Manizales	Manizales		77126		73401	82		96	77		93				
Acuaviva	Palmira	47270	49230	46374	48739		98	97		96	96	1,4	-0,4	1,7	-0,1
Proactiva	Monteria		39746		19646			76			38				
Aap	Popayan	44554	49275	41779	46606		95	98		90	93	3,4	1,1	3,7	1,1
Conhydra	Buenaventura														
Centro agua	Tulua	33677	36135	33049	33899		97	98		95	97	2,4	0,5	0,9	0,9
Acuagyr	Girardot		26135		22571			97			83				
Servaf	Florencia		22509		12285			85			46				
Aguas de Peninsula	Maicao														
Sera q.a.	Tunja		27777		27296			98			96				
Aguas de Guajira	Rioacha														
EMPAS	Sincelejo		35509		31551			79			69				
	Soledad														

Panel B: Municipalities without Private Participation

		Number of users				Coverage (%)						Annual increase 1998-2001			
		Water		Sanitation		Water			Sanitation			Water		Sanitation	
Enterprise	Municipality	1998	2001	1998	2001	1990	1998	2001	1990	1998	2001	Users	Coverage	Users	Coverage
EAAB	Bogota*	1195147	1206160	1082045	1206160	88	93	95	64	93	95	0,3	0,7	3,7	0,6
EPM	Medellin*	694485	760821	680939	728853	98	99	100	94	94	93	3,1	0,3	2,3	-0,6
EMCALI	Cali*	422899	436799	402295	418677	89	92	96	75	94	94	1,1	1,4	1,3	0
E.I.C.E	Cucuta	106869	121991	93913	118489		86	90		96	88	4,5	1,5	8,1	-3
A y A	Pereira		89934		87193	82		96	77		94				
IBAL	Ibague		84276		80042			89			85				
EMPOPASTO	Pasto		53804		53529			89			89				
EE PP	Neiva		65595		62509	86		99	81		95				
EE PP	Armenia		67543		66874			96			95				
EAAV	Villavicencio	48475	53547	53610	59576		72	80		80	89	3,4	3,4	3,6	3,6
EMDUPAR	Valledupar	43606	48648	43610	46754		99	99		87	90	3,7	0	2,3	1,3
	Sogamoso	24078	26602	20004	22455		97	100		66	90	3,4	1,1	3,9	10,9

Notes: * serves cities with population greater than 600,000. The rest serves cities with population between 100,000 and 600,000.

Source: Own construction from CRA (2002), DNP (2005), and Fernandez (2004).

Table 4. Average Tariff
(Pesos per M3/month/users in December 2001)

Panel A: Municipalities with Private Participation		
Enterprise	Municipality	Lower income / higher income tariff (%) **
Triple A*	Baranquilla	55,3
Acuacar*	Cartagena	58,5
Metroagua SA	Santa Marta	68,6
Aguas de Manizales	Manizales	70,0
Acuaviva	Palmira	75,4
Aap	Popayan	66,3
Acuagyr	Girardot	67,9
Servaf	Florencia	65,1
	Average	65,9
Panel B: Municipalities without Private Participation		
EAAB*	Bogota	58,3
EPM*	Medellin	55,5
EMCALI*	Cali	66,6
E.I.C.E	Cucuta	68,3
A y A	Pereira	54,2
IBAL	Ibague	65,6
EMPOPASTO	Pasto	60,6
EE PP	Neiva	60,2
EE PP	Armenia	46,0
EAAV	Villavicencio	71,7
EMDUPAR	Valledupar	54,2
EMPAS	Sincelejo	62,1
	Average	59,3

Notes: * serves cities with population greater than 600.000. The rest serves cities with
** Lower income is the average for stratum 1, 2 and 3, higher income is the average
Source: Authors calculation based on SSPD (2002)

Table 5. Average Consumption (M3/month/user)

	Bogota				Medellin			
	1997	2001	Total variation	Annual Variation	1997	2001	Total variation	Annual Variation
Sratum 1	21,4	14,8	-30,9	-8,8	17,9	13,8	-22,9	-6,3
Sratum 2	22,7	15,4	-32,2	-9,3	19,7	14,9	-24,2	-6,8
Sratum 3	22,0	14,5	-34,2	-9,9	19,6	16,0	-17,4	-5,0
Sratum 4	17,7	13,9	-21,5	-5,9	20,8	18,0	-14,0	-3,6
Sratum 5	19,5	16,2	-17,1	-4,6	24,7	20,2	-17,3	-4,8
Sratum 6	21,8	19,0	-13,1	-3,4	36,0	26,8	-25,5	-7,1
	Cali				Barranquilla			
Sratum 1	23,8	20,0	-16,1	-4,3	14,0	15,7	-11,8	-2,8
Sratum 2	27,6	21,9	-20,6	-5,6	31,1	23,1	-25,8	-7,2
Sratum 3	23,8	21,3	-10,6	-2,8	35,7	23,2	-35,0	-10,2
Sratum 4	23,6	21,6	-8,2	-2,1	37,9	23,8	-37,2	-11,0
Sratum 5	27,6	25,9	-6,3	-1,6	43,2	26,2	-39,4	-11,8
Sratum 6	35,2	35,6	-0,9	0,0	47,6	32,8	-31,1	-8,9
	Bucaramanga				Cartagena			
Sratum 1	29,3	18,9	-35,7	-10,4	21,6	12,8	-40,9	-12,3
Sratum 2	28,4	19,9	-30,0	-8,5	24,2	15,7	-35,0	-10,2
Sratum 3	25,2	19,1	-24,1	-6,7	25,9	17,6	-32,1	-9,2
Sratum 4	24,6	21,4	-13,0	-3,4	27,0	20,0	-25,7	-7,2
Sratum 5	27,8	24,8	-10,8	-2,8	29,9	23,3	-21,8	-6,0
Sratum 6	31,9	29,7	-6,9	-1,8	33,2	22,7	-31,8	-9,1

Source: Authors calculations based on SSPD (2002).

Table 6- Municipalities that appear in both years of the survey

ECV			Additional from DHS		
Municipality	Privatized	Non Privatized	Municpality	Privatized	Non Privatized
Aratoca		x	Alto Baudó		x
Arauca		x	Baranoa		x
Barbosa		x	Betulia		x
Barrancabermeja		x	Buenaventura	x	
Barranquilla	x		Buga		x
Bello		x	Cajibío		x
Bogota		x	Candelaria		x
Bucaramanga	x		Caparrapí		x
Caicedo		x	Chigorodó		x
Caldas		x	Chinú		x
Cali		x	Corozal	x	
Cartagena	x		Coyaima		x
Chia		x	Cumbal		x
Cienaga		x	El Guacamayo		x
Copacabana		x	Istmina	x	
Cucuta		x	Majagual		x
Dos Quebradas		x	Mogotes		x
Envigado		x	Neiva		x
Floridablanca		x	Ortega		x
Girardota		x	Palmira	x	
Giron		x	Plato		x
Ibague		x	Popayán	x	
Itagui		x	Puerto Salgar		x
Lorica		x	Riosucio		x
Los Patios		x	Saboya		x
Manizales	x		Salgar		x
Medellin		x	San Bernardo del Viento		x
Montenegro		x	San jacinto		x
Monteria	x		San Martín		x
Pasto		x	Sibaté		x
Pereira		x	Sogamoso		x
Piedecuesta		x	Subachoque		x
Pitalito		x	Trujillo		x
Providencia		x	Túquerres		x
Riohacha	x		Turmequé		x
Roldanillo		x	Urumita		x
San Andrés		x			
Santa Marta	x				
Santander de Quilichao		x			
Soledad	x				
Tulua	x				
Tumaco		x			
Villa del Rosario		x			
Villamaria		x			
Yopal		x			
Yumbo		x			

Table 7: Descriptive Data

	Panel Municipalities		Privatized		Non privatized		Difference in Difference	
	1997	2003	1997	2003	1997	2003		
Outcome Variables								
a. Coverage								
Access (Dummy 1-0)	0,940	0,959	0,910	0,936	0,948	0,966	-0,001	
Payment	0,076	0,086	0,081	0,095	0,075	0,084	0,005	
b.Quality								
Water treatment (Dummy 1-0)	0,318	0,507	0,330	0,465	0,315	0,519	-0,069	
Frequency of Service (Dummy 1-0)	0,800	0,859	0,771	0,806	0,807	0,874	-0,031	*
Aspect (Dummy 1-0)		0,844		0,819		0,851	-0,032	*
c. Health outcomes								
Health status (Dummy 1-0)	0,724	0,772	0,719	0,768	0,725	0,773	-0,026	
Hospitalizations (Dummy 1-0)	0,074	0,068	0,061	0,072	0,077	0,068	0,019	
Health problems (Dummy 1-0)	0,158	0,102	0,149	0,155	0,160	0,098	0,053	
Diarrea (Dummy 1-0) [1/]	0,157	0,133	0,177	0,145	0,151	0,131	0,007	
Height for weight [1/]	0,095	0,060	-0,068	-0,100	0,138	0,090	0,005	
Household Variables								
a. Infrastructure								
Zone (Urban or rural)	1,119	1,085	1,132	1,086	1,116	1,084	-0,015	
Ownership (Dummy 1-0)	0,806	0,869	0,778	0,809	0,813	0,886	-0,043	*
Rooms (Number of)	3,506	3,504	3,542	3,547	3,497	3,492	0,011	
Risk (Dummy 1-0)	0,001	0,124	0,000	0,169	0,001	0,110	0,060	*
Infrastructure index	0,688	0,669	0,645	0,610	0,700	0,686	-0,021	*
Assets index	0,476	0,482	0,457	0,459	0,480	0,488	-0,006	
b. Human capital								
Number of persons per house	4,022	3,699	4,278	3,952	3,955	3,627	0,002	
Head's education (Total years)	7,473	8,033	7,405	8,075	7,490	8,021	0,140	
Average education (Total years)	7,841	8,895	7,841	9,026	7,841	8,858	0,168	
Head's age	46,200	47,009	45,686	45,586	46,334	47,415	-1,180	*
Recent migrants	0,078	0,100	0,082	0,109	0,077	0,098	0,005	
Head's marital status (Dummy 1-0)	0,676	0,631	0,688	0,634	0,672	0,630	-0,011	
Head's gender (Dummy 1-2, 1=Male)	1,279	1,336	1,275	1,340	1,280	1,335	0,010	
c. Income								
Percapita income (Constant $ 2003)	$ 744.644	$ 466.381	$ 497.036	$ 404.670	$ 809.002	$ 483.980	$ 232.656	*
Percapita consumption (Constant $ 2003)	$ 569.071	$ 538.631	$ 463.272	$ 490.800	$ 596.570	$ 552.272	$ 71.825	*
Head's labor income (Constant $ 2003)	$ 1.000.131	$ 647.908	$ 874.614	$ 534.086	$ 1.033.791	$ 680.893	$ 12.371	
Head employed	0,758	0,738	0,764	0,750	0,757	0,734	0,009	
Municipalities Variables								
a. Exogenous characteristics								
Recent migrantion (Dummy 1-0)	0,105	0,125	0,085	0,091	0,082	0,133	-0,018	
NBI	26,610		29,690		25,744		-3,946	
Population	441576,7		452813,8		438416,3		-14397,5	
Surface area (Kms2)	966,250		1409,333		852,314		-557,019	
Distance to state capital (Kms)	49,818		12,222		59,486		47,263	
Altitude (From sea level)	1016,886		480,889		1154,714		673,825	
b. Tecnical capacity indices (TCI)								
Own resources	23,828	26,740	25,772	24,573	23,282	27,267	-5,184	
Saving capacity	57,357	74,345	56,354	77,725	57,639	73,523	5,487	
Income from national transfers	40,060	54,337	43,758	63,757	39,021	52,046	6,973	

Source: Authors calculations with data from DANE for municipalities characteristics , DNP for TCI

Note: *Statistically significant at the 5% level; **Statistically significant at the 10% level; Difference in time and between privatized and non privatized

[1/] These two variables come from the DHS survey and the years before and after privatizations are 1995 and 2005 respectively.

Table 8 - Water coverage

Dependent Variable: Access (Dummy 1-0)												
				Quintiles		Urban			Rural			
Privatized (P)	-0,0057	0,0042	***	0,0028	*	0,0077	**	-0,1035	0,0353	0,5103	***	
	-0,0068	-0,0015		-0,0016		-0,0032		-0,1535	-0,1561	-0,1537		
Time (t)	-0,0008	-0,0014	**	-0,0005		-0,0011		-0,0040	**	-0,0193	0,0624	
	-0,0005	-0,0006		-0,0008		-0,0008		-0,0017	-0,0332	-0,0570		
P*t	-0,0003	-0,0031				0,0024	***	0,0012	-0,4570	***	-0,5746	***
	-0,0012	-0,0020				-0,0007		-0,0008	-0,0589	-0,0570		
Quintile1*P*t				-0,0022								
				-0,0032								
Quintile2*P*t				-0,0046								
				-0,0046								
Quintile3*P*t				-0,0025								
				-0,0038								
Quintile4*P*t				-0,0149								
				-0,0215								
Quintile5*P*t				-0,0007								
				-0,0043								
R-Squared	0,58	0,58		0,59		0,35		0,37	0,28	0,31		
No. Obs.	21406	21003		21003		15852		15693	2197	1922		
TCI	No	Yes		Yes		No		Yes	No	Yes		

Notes:
Standard errors in parenthesis
All regressions include the controls described in the text and in Table 7
* significant at 10%, ** significant at 5%,*** significant at 1%

Table 9 - Payment

Dependent Variable: Payment (% of total income of the household)												
				Quintiles		Urban			Rural			
Privatized (P)	-0,0422	-0,0134		-0,1113		-0,0246	-0,0192		-0,0273	*	-0,0205	
	-0,0737	-0,2463		0,2466		-0,0236	-0,0316		-0,0146		-0,0218	
Time (t)	0,0103	**	0,0203	**	0,0043		0,0106	0,0238		0,0142	**	0,0140
	-0,0046	-0,0080		0,0176		-0,0066	-0,0170		-0,0057		-0,0091	
P*t	-0,0076	-0,0021				-0,0092	-0,0034		-0,0085		0,0318	*
	-0,0105	-0,0116				-0,0328	-0,0337		-0,0104		-0,0177	
Quintile1*P*t				0,0713	**							
				-0,0359								
Quintile2*P*t				0,1116	***							
				-0,0266								
Quintile3*P*t				-0,0140								
				-0,0236								
Quintile4*P*t				-0,1029	***							
				-0,0215								
Quintile5*P*t				-0,0037								
				-0,0204								
R-Squared	0,04	0,04		0,05		0,04	0,04		0,20	0,20		
No. Obs.	16398	16168		16168		15321	15201		1077	967		
TCI	No	Yes		Yes		No	Yes		No	Yes		

Notes:
Standard errors in parenthesis
All regressions include the controls described in the text and in Table 7
* significant at 10%, ** significant at 5%,*** significant at 1%

Table 10 - Quality

Dependent Variable: Water Treatment (Dummy 1-0)															
					Quintiles			Urban				Rural			
Privatized (P)	-0,3349	***	-0,3045	*	-0,2561			-0,3632	***	0,0045		0,2504		-0,1285	
	-0,0646		-0,1684		-0,1825			-0,0860		-0,1438		-0,1962		-0,2065	
Time (t)	0,2401	***	0,2961	***	0,1643	***		0,2620	***	0,3407	***	0,1085	***	0,0628	
	-0,0121		-0,0194		-0,0369			-0,0132		-0,0227		-0,0305		-0,0478	
P*t	-0,1011	***	-0,0868	***				-0,1021	***	-0,0644	*	0,0286		0,0981	
	-0,0276		-0,0299					-0,0310		-0,0354		-0,0662		-0,0754	
Quintile1*P*t					0,0425										
					-0,0764										
Quintile2*P*t					-0,0474										
					-0,0618										
Quintile3*P*t					-0,0800										
					-0,0624										
Quintile4*P*t					-0,1324	**									
					-0,0594										
Quintile5*P*t					-0,0342										
					-0,0660										
R-Squared	0,1494		0,1516		0,1617			0,1692		0,1717		0,1251		0,1242	
No. Obs.	22475		22072		22072			20076		19888		2383		2168	
TCI	No		Yes		Yes			No		Yes		No		Yes	
Dependent Variable: Frequency of Service (Dummy 1-0)															
Privatized (P)	0,2784	***	0,2963	***	0,2570	***		0,2547	***	0,2719	***	-0,5069	**	-0,6777	***
	-0,0246		-0,0287		-0,0316			-0,0263		-0,0312		-0,2161		-0,1917	
Time (t)	0,0587	***	0,0564	***	0,0384			0,0692	***	0,0489	***	-0,0884	**	-0,1134	
	-0,0090		-0,0136		-0,0246			-0,0094		-0,0165		-0,0413		-0,0758	
P*t	-0,0381	*	-0,0421	*				-0,0544	**	-0,0306		0,2158	***	0,2357	***
	-0,0217		-0,0220					-0,0240		-0,0219		-0,0655		-0,0699	
Quintile1*P*t					0,0184										
					-0,0384										
Quintile2*P*t					0,0614	***									
					-0,0173										
Quintile3*P*t					0,0091										
					-0,0329										
Quintile4*P*t					-0,1999	***									
					-0,0733										
Quintile5*P*t					-0,2831	***									
					-0,0849										
R-Squared	0,3178		0,3087		0,3180			0,3461		0,3275		0,2247		0,2190	
No. Obs.	20570		20296		20296			18975		18796		1311		1225	
TCI	No		Yes		Yes			No		Yes		No		Yes	
Dependent Variable: Aspect (Dummy 1-0)															
Privatized (P)	0,1776	***	-0,0979					-0,0927		0,0976	*	-0,0234		0,0904	
	-0,0524		-0,1600					0,0753		-0,0546		-0,1393		-0,0947	
Quintile1*P					-0,2714										
					-0,2392										
Quintile2*P					-0,1403										
					-0,1997										
Quintile3*P					-0,1808										
					-0,2126										
Quintile4*P					-0,0513										
					-0,1599										
Quintile5*P					-0,1045										
					-0,1871										
R-Squared	0,1197		0,1197		0,1239			0,1332		0,1332		0,0881		0,0881	
No. Obs.	17569		17569		17569			16123		16123		1337		1337	
TCI	No		Yes		Yes			No		Yes		No		Yes	

Notes:

Standard errors in parenthesis

All regressions include the controls described in the text and in Table 7

* significant at 10%, ** significant at 5%,*** significant at 1%

Table 11 - Privatization With Technical Capacity of the Municipalities

	Access		Payment		Quality	
	(Dummy 1-0)		(% of total income of the household)		Frequency of Service (Dummy 1-0)	
Local tax revenues * Privatized	0,0006	**	-0,0086	***	-0,0213	
	-0,0003		-0,0033		-0,0140	
Saving Capacity * Privatized	0,0013	***	-0,0171		-0,0844	***
	-0,0004		-0,0191		-0,0145	
Transfers * Privatized	-0,0001		0,0063		0,0415	***
	-0,0003		-0,0112		-0,0072	
R-Squared	0,58		0,04		0,32	
No. Obs.	21003		16168		20296	

Notes:
Standard errors in parenthesis
All regressions include the controls described in the text and in Table 7
* significant at 10%, ** significant at 5%,*** significant at 1%

Table 12 - Health

Dependent variable: Children with diarrhea in the last 2 weeks (%)												
					Urban				Rural			
Privatized (P)	-0,0470		-0,0640		0,1994		-0,0477		-0,1893	***	-0,1098	
	0,0503		0,0497		-0,1882		-0,0775		-0,0417		-0,2006	
Time (t)	-0,0342	***	-0,0469	***	-0,0380	***	-0,0497	**	-0,0374	**	0,0155	
	0,0098		0,0219		-0,0121		-0,0229		-0,0167		-0,0809	
P*t	0,0074		0,0043		-0,0051		0,0058		0,1191	*	-0,1515	***
	0,0184		0,0288		-0,0192		-0,0302		-0,0715		-0,0555	
R-Squared	0,03		0,03		0,04		0,03		0,05		0,16	
No. Obs.	9649		4958		6788		4551		2824		402	
TCI	No		Yes		No		Yes		No		Yes	
Dependent variable: Weight for Height standard deviations from the reference median												
					Urban				Rural			
Privatized (P)	-0,2352		-0,4075		0,2129		0,2324		-0,6134	**	-0,6606	
	0,1732	*	0,1355	***	-0,6782		-0,2686		-0,2736		-0,6433	
Time (t)	-0,0460		-0,0371		-0,0567		-0,0274		-0,0051		-0,4867	**
	0,0284	**	0,0627		-0,0358		-0,0458		-0,0659		-0,2121	
P*t	0,0337		0,2693		-0,0006		0,2895	*	0,2480	***	0,2167	
	0,0539		0,0819	***	-0,0604		-0,1522		-0,0856		-0,3088	
R-Squared	0,04		0,04		0,05		0,07		0,04		0,15	
No. Obs.	9214		4735		6505		2709		4342		393	
TCI	No		Yes		No		Yes		No		Yes	

Notes:
Standard errors in parenthesis
All regressions include the controls described in the text and in Table 7
* significant at 10%, ** significant at 5%,*** significant at 1%

Appendix 1. Technical Capacity Indices

Figure 1.

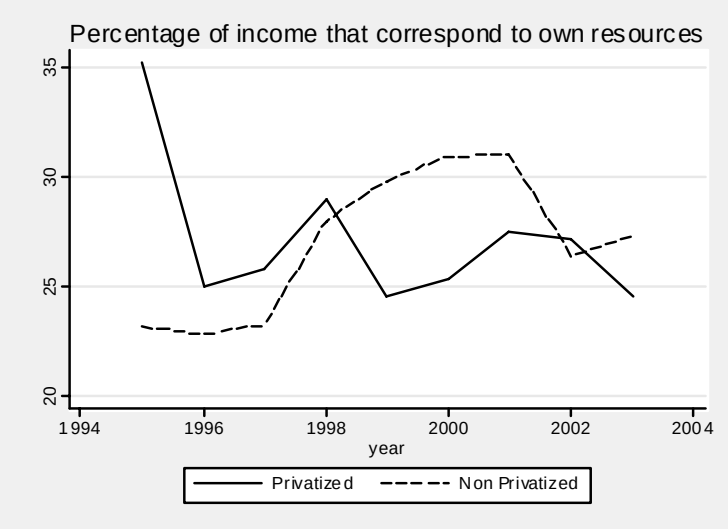


Figure 2.

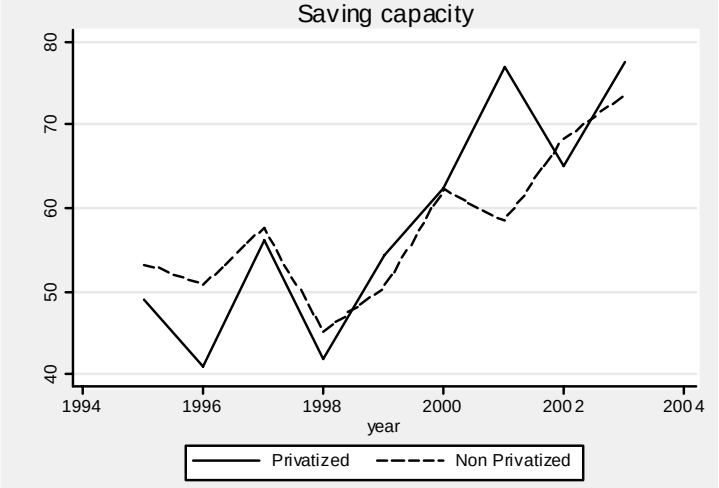


Figure 3.

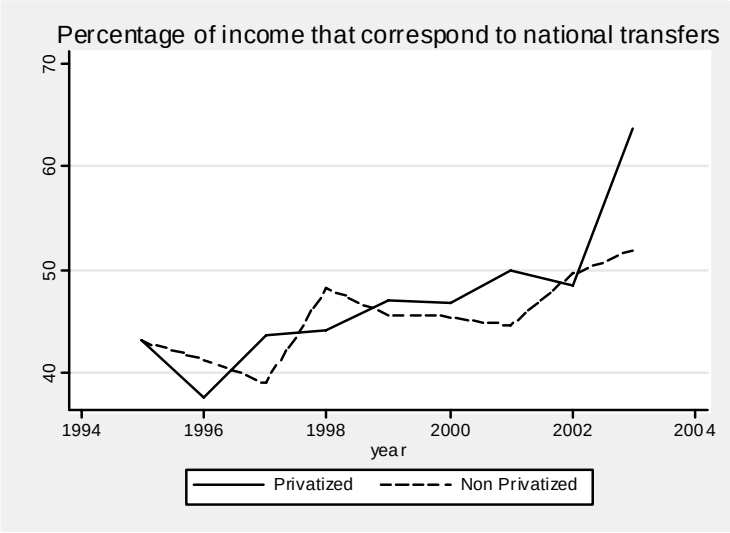

Percentage of income that correspond to national transfers
70
60
50
40
1994
1996
1998
2000
2002
2004
year
Privatized
Non Privatized

Figure 4.

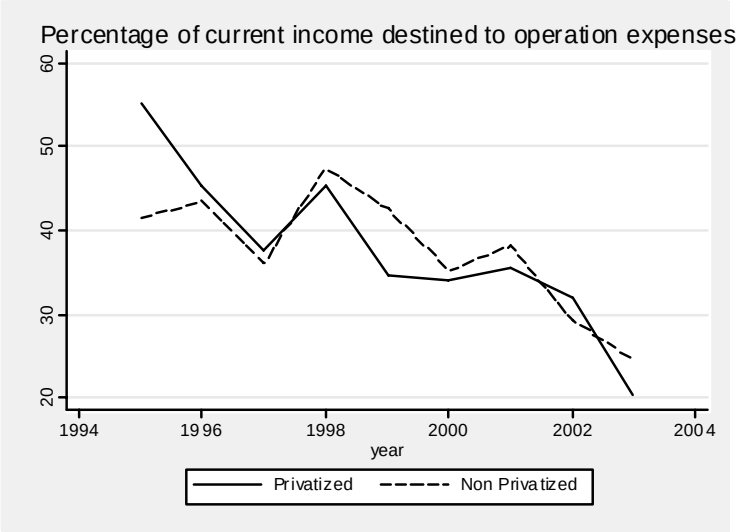
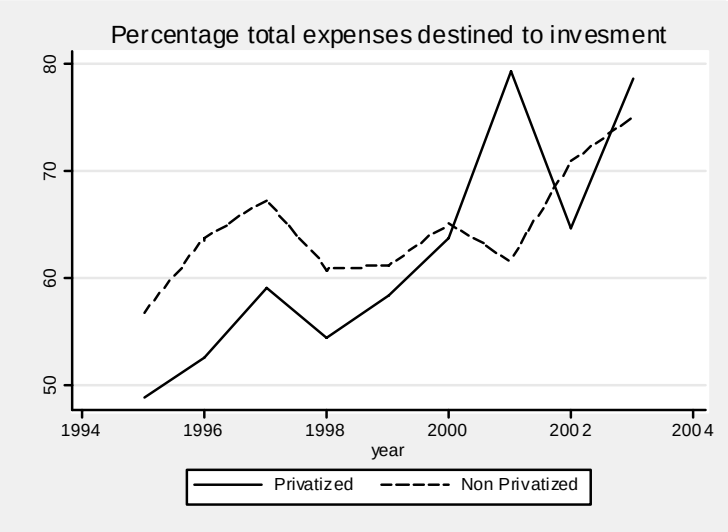

Percentage of current income destined to operation expenses
60
50
40
30
20
1994
1996
1998
2000
2002
2004
year
Privatized
Non Privatized

Figure 5.


Percentage total expenses destined to invesment
80
70
60
50
1994
1996
1998
2000
2002
2004
year
Privatized
Non Privatized

Appendix 2. Questions from the ECV

This annex presents the questions that we used to construct the dependent variable of the study. for the sake of space we present questions numbers referring to the ECV 2003, the questions for 1997 where made comparable.

I. Access to public services: water, sewer and energy.

Question c3: Payment of electricity (includes option of "not connected")
Question c4: How much did you pay for electricity
Question c6: Which type of sewer do you have? (includes option of "not have")

II. Quality of services: perception of quality of services and health outcomes:

Question c5: How do you consider the quality of the energy? (Options: very bad, bad, regular, good and very good)
Question c18: Does the service of water comes all seven days of the week?
Question c19: In the days that it arrives, it is continuous 24 hours?
Question c22: Does the water presents the following characteristics? Particles, bad taste, bad odor, bad color, none of the above
Question f8: The health of each member of the household is: very good, good, regular, bad
Question f11: In the last 30 days, did you have any disease, accident, or other health problem?
Question f24: In the last 12 months, did you have to be in the hospital?

The last three question where considered only for children 5 years of age and younger, under the assumption that access and quality of water is one of the most important determinants of health outcomes in children.

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