



Fiscal decentralisation and infant mortality rate: The Colombian case

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ABSTRACT

There is a paucity of research analysing the influence of fiscal decentralisation on health outcomes. Colombia is an interesting case study, as health expenditure there has been decentralising since 1993, leading to an improvement in health care insurance. However, it is unclear whether fiscal decentralisation has improved population health. We assess the effect of fiscal decentralisation of health expenditure on infant mortality rates in Colombia. Infant mortality rates for 1080 municipalities over a 10-year period (1998–2007) were related to fiscal decentralisation by using an unbalanced fixed-effect regression model with robust errors. Fiscal decentralisation was measured as the locally controlled health expenditure as a proportion of total health expenditure. We also evaluated the effect of transfers from central government and municipal institutional capacity. In addition, we compared the effect of fiscal decentralisation at different levels of municipal poverty. Fiscal decentralisation decreased infant mortality rates (the elasticity was equal to -0.06). However, this effect was stronger in non-poor municipalities (-0.12) than poor ones (-0.081). We conclude that decentralising the fiscal allocation of responsibilities to municipalities decreased infant mortality rates. However, this improved health outcome effect depended greatly on the socio-economic conditions of the localities. The policy instrument used by the Health Minister to evaluate municipal institutional capacity in the health sector needs to be revised.

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Introduction

Colombia has one of the most decentralised health systems in Latin America (Bossert, Larrañaga, Giedion, Arbelaez, & Browser, 2003). The reassignment of government functions and responsibilities for providing health services across different levels of government began in 1993 and led to the transfer of political and fiscal responsibilities to 32 departments and 1120 municipalities. The Colombian decentralisation process has been recognised as a successful one, bringing about a substantial improvement in access to health services (Bossert et al., 2003). The percentage of Colombians covered by health insurance rose dramatically between 1992 and 2005, from 27% to 70% (Pinto & Hsiao, 2006). Insurance coverage was extended to the most vulnerable sections of the population: children and mothers who are heads of a household, the poorest older adults, and people in rural areas (Pinto & Hsiao, 2006).

During this process, municipal authorities have acquired an increasingly prominent role in the provision of primary health services (Bossert et al., 2003). Municipal governments have also been given responsibility for allocating some resources in the health

sector (Plaza, Barona, & Hearst, 2001). More than 30% of public health resources are now allocated by municipalities (DNP, 2008). This municipal power to allocate resources raises the question of the effect of this policy on the performance of the health system. In theory, increased local responsibilities should translate into improved access to health care services and ultimately, into a better health status for the population (Saltman et al., 2006, chap. 1). The transfer of responsibilities to municipal authorities is based on the assumption that locally managed services should be better suited to meeting divergent local needs than centrally managed services (Oates, 1972). For example, decentralisation might help reduce inequalities within municipalities, as municipal authorities are more knowledgeable about the local context and hence better placed to respond to the priority needs of their communities by, for example, focussing on marginalised or poor groups.

However, the assumption of the effectiveness of decentralisation in improving the local provision of health services and health outcomes remains a contentious topic. The types of services and the local institutional context that local authorities have to face play an important role in the provision of services. The provision of some health services is characterised by the presence of market failures, such as spillover behaviours that might reduce the incentives for their provision (Foster and Enikolopov, 2001). Moreover,

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adequate institutional capacities allow authorities to respond effectively to local priorities (Bossert & Mitchell, 2011). Those capacities can include the administrative, technical, organisational, financial, and human dimensions of health sector institutions. Nevertheless, previous studies have shown that drawbacks associated with governance, including low local expertise in management, poor accountability and poor local participation, capture by vested interests, low local degree of choice between different functions, and limited fiscal resources, lead to inefficiencies in the allocation of resources (Bossert & Mitchell, 2011; Mello and Barestain, 2001). This might translate into limited provision and thus undermine the effect of decentralisation on health outcomes.

So far, much of the literature has focused on the evaluation of subnational provision of health services, and few studies have tested the likely consequences of decentralisation for health status (Jiménez-Rubio, 2010). In the literature on this latter subject, previous empirical studies have found a positive effect of decentralisation – mainly measured in fiscal terms as the percentage of total expenditures or revenues accounted for by local government – on health outcomes (see overview of empirical decentralisation studies in Table 1). Habibi et al. (2003) showed that infant mortality decreased with two measures of fiscal decentralisation, by using a large panel of Argentine provinces over the period 1970–1994. In addition, this study also found that disparities in regional infant mortality rates declined significantly over the period after decentralisation reforms were undertaken. Robalino et al. (2001) found the same relationship by using panel data for low- and high-income countries during the period 1970 to 1995. In this study, the results also suggested that the marginal benefits from fiscal decentralisation were noticeably higher for poor countries. Asfaw, Frohberg, James, and Jütting (2007) tested the impact of fiscal decentralisation on rural infant mortality rates in India between 1990 and 1997. The results of this study also indicate that the effectiveness of fiscal decentralisation was strongly linked to the level of political decentralisation. Cantarero and Pascual (2008) and Jiménez-Rubio (2010) also showed that fiscal decentralisation was inversely related to infant mortality rates in the Spanish regions and Canadian provinces, respectively. However, studies used a health care measure related to fiscal decentralisation on health, such as the ratio of subnational health expenditure to the total, instead of overall public-sector indicators.

The purpose of this paper was to assess the effect of Colombian fiscal decentralisation on infant mortality rates. We seek, in general,

to contribute to the emerging empirical literature that tries to measure this effect, and in particular, to analyse a specific developing-country experience. One particular reason for this approach is that most studies of fiscal decentralisation in Latin American countries have focused on the budgetary constraints facing local government and how these can affect macroeconomic stability (Bonet, 2006; Faguet, 2004).

Colombia has experienced a significant decrease in infant mortality rates, and in parallel, an increasing decentralisation of health resources. The most specific health competences shifted to the municipalities lie in the domains of promotion, health education, and preventive health care. In this way, municipalities were encouraged to channel local resources to meet their new responsibilities at local level (DNP, 2008). In figures, local health resources, as a proportion of total health spending, increased from 1.1% in 1994 to 6.1% in 2003 (Baron, 2007). In addition, other legislative mandates defined municipal functions along with resources for financing health services provision. However, budgetary control of transfers from central government at local level relies on administrative institutional capacities. A few municipalities (capitals and more developed municipalities) were certified as suitable for decentralisation since they met these institutional requirements. This showed that the decentralisation process in Colombia has been unequal across municipalities, depending on local management capacity and also on institutional and socio-economic conditions. As a result, the effect of decentralisation on health outcomes is unclear across municipalities.

Data and methods

Data

This study was carried out using a panel of 1080 municipalities over a 10-year period (1998–2007). Municipality is the smallest political-administrative unit in Colombia. We excluded from the analysis 40 municipalities (over the total equal to 1120), because of missing data.

Dependent variable

Infant mortality rates were used as a measure of health outcome. The infant mortality rate is defined as the number of deaths of infants under one year of age per 1000 live births in a given municipality. This health indicator is considered to be a good

Table 1
Summary of previous studies on the effect of fiscal decentralisation on infant mortality rates.

Authors	Area of study	Panel – years	Fiscal decentralization measure	Main conclusion
Habibi et al. (2003)	Argentina provinces	1970–1994	Percentage of resources raised locally and ratio of locally controlled resources to the total	Decentralisation had a negative impact on infant mortality rates. Comparing decentralisation patterns across low-income and high-income provinces, disparities in regional infant mortality rates declined significantly over the period after decentralisation reforms were undertaken.
Robalino et al. (2001)	Low and high-income countries	1970–1995	Proportion of subnational government spending over central government spending	Decentralisation was related to lower infant mortality rates. The marginal benefits from fiscal decentralisation were noticeably higher for poor countries
Asfaw et al. (2007)	Rural India	1990–1997	Share of local rural expenditure on total state intermediate government expenditure, local total expenditure per rural population and share of local own resources on total local expenditure.	Decentralisation was negative associated with infant mortality rates. The effectiveness of fiscal decentralisation was strongly linked to the level of political decentralisation
Cantarero and Pascual (2008)	Spanish regions	1992–2003	Share of subnational health expenditure to the total	Fiscal decentralisation was inversely related to infant mortality rates in the Spanish regions
Jiménez-Rubio (2010)	Canadian provinces	1979–1995		Fiscal decentralisation was inversely related to infant mortality rates in the Canadian provinces

indicator of population health, and also reflects both children's health and pregnant women's health (Jiménez-Rubio, 2010). This is also known to be a sensitive outcome of health system reforms (Hutton, 2000). Data on infant mortality rates was obtained from the national census and vital statistics collected by the National Administrative Department of Statistics.

Independent variables

Decentralisation in general is a complex process. Rondinelli (1983) developed a theoretical framework to analyse this process. Decentralisation has been described as the transfer of power between political levels (devolution), between administrative levels (deconcentration), and from political to relatively independent institutional levels (delegation) (Saltman et al., 2006, chap. 1). In this paper, "decentralisation" is used to be synonymous with devolution, since our aim was to study the effect of political reforms that promote fiscal autonomy at the municipal level.

Fiscal decentralisation variable

Theoretically, under decentralisation it is expected that local expenditure priorities are consistent with local needs and consequently lead to an improvement in social outcomes (Faguet, 2004). Since decentralisation promotes citizen-centred local governance, a measure of fiscal decentralisation should reflect responsible governance at the local level (Boadway & Shah, 2009).

The most common measure of fiscal decentralisation is the subnational share of total government revenue or expenditure (Cantarero & Pascual, 2008). However, this measure gives only a limited representation of fiscal decentralisation in the sense that it does not take into consideration the control local authorities have over the funds raised locally or other local potential resources (Meloche, Vaillancourt, & Yilmaz, 2004). Therefore, a more appropriate measure for fiscal decentralisation should include only the resources used to cover health care cost for which local authorities have power of decision-making. In this study, we tried to improve this measure by identifying the health expenditure over which local authorities had autonomy and their discretion on those resources.

We therefore measured fiscal decentralisation as locally controlled health expenditure as a proportion of total health expenditure. The numerator included resources for local tax, credits, and other local resources. The proportion of the budget assigned to all local authorities to cover any local needs and which local authorities decided to assign to the health sector was also included. The denominator included total health expenditure (locally controlled health resources, health transfers from central government, and other resources of transfers such as health expenditure with joint financing from higher levels of governments).

Other fiscal variable

Another major source of health expenditure was also analysed: the health transfers from central government. This variable included the health fiscal resources that come from Law 60 for the period 1998–2001 ("Situado Fiscal") and from Law 715 for the period 2002–2007 ("Sistema General de Participaciones"). Inter-governmental transfers are mainly intended to maintain health insurance for the poorest people, to increase health insurance coverage, and to develop primary health care programs. These resources are distributed between municipalities based on the population served, population for attending, poverty levels, and other indicators at the municipal level.

All data on health fiscal resources came from the National Planning Department and the panel included data from 1995.

Institutional capacity

A municipality's institutional capacity to manage resources and to decide on their allocation to the health sector was measured on the basis of its certified status. This status is granted by the Health Minister, who first granted the certificates in 2001. The municipality's certification depends on administrative, technical, and fiscal conditions that have to be met for it to receive transfers directly from central government. These conditions include: functional information systems, the adoption of a developing local health plan, the creation of a local health fund and local health bureau, and agreement with the Health Ministry on institutional arrangements. Only certified municipalities can directly manage transfers from central government. These municipalities take on responsibility for health service provision and the organisation and administration of human resources. If the municipality cannot meet these conditions, then the department is required to take on health sector responsibilities, and therefore becomes the authority for allocating health transfers from government at local level. After being certified, the municipality's mayor becomes the head of the municipal health system, with the responsibility of developing local health plans that are integrated into the municipal plans. The number of accumulated years for which the municipality has received the certified status is used as a proxy indicator of institutional capacity for appropriately managing health transfers from central government as well as of how local authorities have gained experience in managing those resources. The data for this variable came from the Health Minister.

Other local independent variables

In order to analyse structural municipal socio-economic conditions, we used the percentage of households with unsatisfied basic needs. This indicator, widely used in Latin-America, included inadequate access to housing, lack of access to services such as water, electricity, and sanitation, high levels of economic dependence, and school-age children not attending school (DANE, 2005). This data came from the National Administrative Department of Statistics, and so has been widely used as a proxy of municipal socio-economic conditions as it indicates the percentage of households considered to be poor. Other local variable used was the level of urbanisation and this data came from the population census and the National Planning Department.

Method

We followed the theoretical framework developed by Aswaf et al. (2007), which relates decentralisation to health outcomes and takes account of fiscal and political decentralisation. We tested the hypothesis that shifts towards more fiscal decentralisation in health services would be associated with reduction of infant mortality rates by using an unbalanced fixed effects model with robust errors. This relationship is described as follows:

$$Y_{mt} = \alpha_m + \beta_1 X_{1mt} + \beta_2 X_{2mt} + \beta_3 C_{mt} + \beta_4 C_{mt} * X_{2mt} + L' \delta_{mt} + \mu_{mt} \quad (1)$$

where Y_{mt} is the infant mortality rate in the municipality m and year t ; α_m is municipal-specific effect; X_{1mt} corresponds to the locally controlled health expenditure as a proportion of total health expenditure, X_{2mt} refers to the health transfers from central government as a proportion of total health expenditure; C measures the number of accumulated years of municipality with certification status which values rank from zero to maximum equal to seven; L is a vector of local structural indicators and μ_{mt} is equal to $\mu_m + v_{mt}$, where μ_m is the municipal-specific unobserved effect

Table 2
Variable names and summary statistics.

Variables	Mean	Mean	SD	Minimum	Maximum	Observations
Dependent variable						
Infant mortality rate by 1000 births	overall	41.07	33.80	5.32	864.00	N
	between		24.19	13.91	367.44	n
	within		23.85	–302.18	641.16	T-bar
Independent variables						
Locally controlled health expenditure as a proportion of total health expenditure (%)	overall	6.74	12.42	0.00	92.23	N
	between		6.44	0.00	53.81	n
	within		10.62	–31.56	78.32	T-bar
Transfers from central government as a proportion of total health expenditure (%)	overall	82.46	18.39	3.66	100.00	N
	between		9.78	35.31	100.00	n
	within		15.76	2.11	133.63	T-bar
Sum of years of municipality with certification status – period 2001–2007	overall	1.27	1.87	0	7	N
	between		1.09	0	5	n
	within		1.53	–2.23	5.47	T-bar
Households with unsatisfied basic needs (%)	overall	43.91	22.0	1.1	104.5	N
	between		21.0	6.6	100.0	n
	within		7.6	–1.4	88.1	T-bar
Municipality population	overall	41,747	231,140	678	7,050,228	N
	between		226,842	1004	6,507,793	n
	within		18,299	–475,557	584,183	T-bar

and v_{mt} is the remainder disturbance. Dummy variables for each year were included to control for any temporary unobserved changes that might similarly affect all provinces in a given year, such as a national vaccination programme launched by the central government. Table 2 presents summary statistics.

The fixed effect models with robust standard error were estimated using Stata 10, which took within-municipalities changes into account in the estimation process reducing the bias of omitted variable (Verbeek, 2004). Health resources were lagged three years to deal with possible endogeneity problems in the model estimation. In our case, endogeneity may arise from a reverse causality problem since not only has the level of health expenditures an effect on infant deaths, but municipal governments may decide upon the budget for health partly on the basis of the current or expected level of infant mortality. Using a three-years lag for expenditure on health solves the possible endogeneity problem, as the decisions in question cannot be determined by the current infant mortality rate but the relationship between health expenditure and health outcome is maintained.

Existing evidence on decentralisation and infant mortality has shown greater benefits from decentralisation in poor countries/regions than in more well-off countries or regions (Habibi et al., 2003; Robalino et al., 2001). So we tested the relationship described in (1) by non-poor and poor municipalities. In order to identify the non-poor and poor municipalities in our sample, we searched in our first-year panel, 1998, those municipalities that presented a percentage of households with unsatisfied basic needs lower/higher than the median value (49.5) of this percentage of households in 1993. In our unbalanced panel, in 1998, it was possible to identify only 987 of those municipalities. Subsequently, we divided that sub-sample of selected municipalities into two groups of municipalities; hereafter those groups will be referred to as non-poor and poor municipalities, respectively. We used the percentage of unsatisfied basic needs in 1993 to select this sub-sample of municipalities, as that was the year the fiscal decentralisation process started. This allowed us to identify the municipalities that started the decentralisation process with better socio-economic conditions than others.

Results

The Colombian infant mortality rate has been falling since the 1980s (DANE, 1998). The indicator passed from 32 per 1000 births

in 1986 to 16 per 1000 births in 2007 (see Fig. 1). In spite of this significant decrease in infant deaths, enormous differences across municipalities remained. In 2007, infant mortality rates ranged from a minimum of 8.9 per 1000 births to a maximum of 110.9 per 1000 births across municipalities.

Municipalities gained an increasing role in the allocation of health expenditure. While municipalities accounted for 3.8% of total health expenditure in 1995, their share was 4.7% in 2007, with a peak of 9.6% in 2001. However, one important aspect of the health decentralisation process in Colombia was the extent to which municipal authorities depended on transfers from central government. As can be seen from Table 2, such transfers accounted for 82.5% of total municipal health expenditure for the period 1998–2007.

Turning to the local institutional context: in 2001, the first year the certification process was in operation, only 35.4% of municipalities acquired this status. This percentage increased to 56.16% in 2002, but fell again to 44.9% in 2007. On average, certified municipalities were certified for almost two consecutive years during 2001–2007 (see Table 2). Certified status was kept for at least six years by 34.6% of the municipalities. Most of those municipalities were capitals of departments and had populations of over 60,000 habitants. In other words, they were the biggest and most developed municipalities. In 2001, when the certification law came into effect, certified municipalities had a lower infant mortality rate

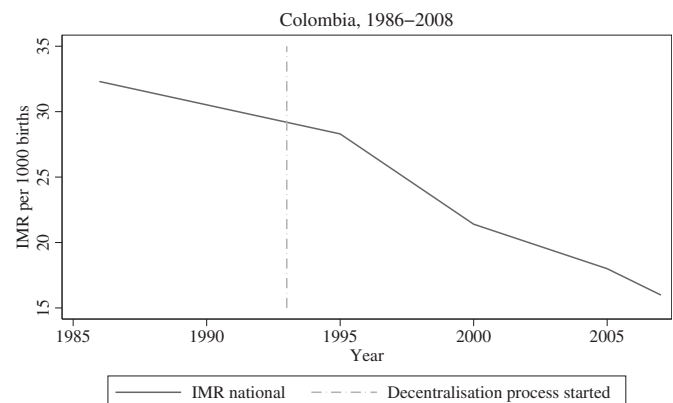


Fig. 1. Infant mortality rate per 1000 births (IMR). Note: Data from Macro International Inc, 2010. Measure DHS tatcompiler. <http://www.measuresdhs.com>; Unicef, 2008.

than non-certified municipalities (38.5 per 1000 vs 45.1). In 2007, the difference has decreased slightly (32.9 per 1000 vs and 38, see Fig. 2).

Table 3 shows the effect of Colombian decentralisation on municipal infant mortality rates over the complete sample of municipalities. The *F*-test results showed that, taken jointly, the coefficients were significant. The Hausman's specification test was also estimated to determine the appropriateness of the random-effects specification. As should be expected in a large panel, the test results indicated that a fixed effect model was a better specification for all the relationships analysed. A Fisher test was also calculated in order to determine whether all the series were non-stationary. The test results showed that least one series in the panel was stationary in all of the relationships analysed. The elasticity of infant mortality with respect to fiscal decentralisation was small and statistically significant: broadly, an increase of 1% of locally controlled health expenditure as a proportion of total health expenditure leads to a reduction of 6% of infant mortality. The transfers from central government as a proportion of total health expenditure were also significantly related to low infant mortality (elasticity equal to 7). By contrast, accumulated years of municipality with certification status were not significant associated with infant mortality (see Table 3, column 2).

The interaction between accumulated years of municipalities with certification status and transfers from central government was not also statistically significant associated with mortality (see Table 3 column 2). The regression results also showed that local socio-economic conditions played a role in the fall in the infant mortality rate. A 1% increase in the percentage of households with unsatisfied basic needs in the municipalities was associated with a 5% increase of infant mortality per 1.000 births (Table 3 columns 1–2). Higher urbanisation was associated with 3.3% fewer infant deaths.

Further analyses according to municipal level of poverty were carried out. During the years 1998–2007 infant mortality rates were positively correlated to the percentage of households with unsatisfied basic needs (see Fig. 3). This correlation increased over time; it passed from 0.25 in 1998 to 0.75 in 2005. Compared to non-poor municipalities, poor municipalities showed higher infant mortality, 33 as against 48.8 per 1000 births, respectively. In addition, local health resources were differentiated by municipal levels of poverty. On average, non-poor municipalities showed to expend 1.5 times more local health resources than poor ones, 8.6% and 5.8%, respectively.

The Chow test was used to determine whether the coefficients of Equation (1) varied according to municipal levels of poverty. The

Table 3

Infant mortality rate (Ln) in Colombia 1998–2007: results of unbalanced fixed effect model.

Variables	Coef. (1)	Coef. (2)
Fiscal decentralisation		
Locally controlled health expenditure as a proportion of total health expenditure (Ln)	−0.060 [0.029]**	−0.062 [0.029]**
Transfers from central government and Institutional capacity		
Transfers from central government as a proportion of total health expenditure (Ln)	−0.050 [0.029]*	−0.072 [0.033]**
Accumulated years of municipality with certification status t		0.006 [0.007]
Transfers from central government as a proportion of total health expenditure (Ln) * Accumulated years of municipality with certification status t		0.016 [0.012]
Local variables		
Households with unsatisfied basic needs (USB) (Ln)	0.041 [0.014]***	0.047 [0.013]***
Municipality population (Ln)	−0.033 [0.013]**	−0.033 [0.013]**
Number of municipalities-years	10,449	10,321
Number of municipalities	1080	1080
R-squared	0.135	0.141
Breusch and Pagan Lagrangian multiplier test for random effects	19484.86***	18113.15***
Hausman test for difference in coefficients not systematic	Fixed Effects 142.48***	Fixed Effects 177.85***
Fisher test for panel unit root using an augmented Dickey–Fuller test	2562.65 ***	2481.31***

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level; robust standard errors are in brackets; unbalanced fixed-effects regression controlling for municipality- and year-effects; each health expenditure variable was lagged three-years and was measured as a logarithm; R^2 for within-countries estimator reported; the constant term was calculated but not reported.

result of this test suggested the coefficients of municipal level of poverty were statistically different and it allowed us to divide the sample into two groups of municipalities: poor and non-poor ($F(5, 8632) = 4.07$; p -value < 0.001).

The findings in Table 4 showed that the small coefficient of locally controlled health expenditure as a proportion of health expenditure estimated overall municipalities translated into a differentiated effect by non-poor and poor municipalities. Comparing column 2 with column 4 of Table 4, the results suggested that fiscal decentralisation decreased infant mortality by 12% in non-poor municipalities, while this effect was just 8.1% in the poor ones.

The transfers from central government as a proportion of total health expenditure was associated with reducing infant deaths in non-poor and poor municipalities (see Table 3, column 1 and 3). However, this effect was not longer statistically significant when the interaction between accumulated years of municipalities with certification status and those health fiscal resources was included in the estimation (see Table 4, columns 2 and 4).

Discussion

Our main results suggest that fiscal decentralisation reduced infant mortality rates in Colombia and that this reduction was higher in non-poor municipalities than in poor municipalities.

Decentralising fiscal allocative responsibilities for the provision of primary health services to municipal authorities is associated with low infant mortality. This result supports the idea that decentralisation leads to a more efficient allocation of resources at local level by allowing local authorities to allocate resources

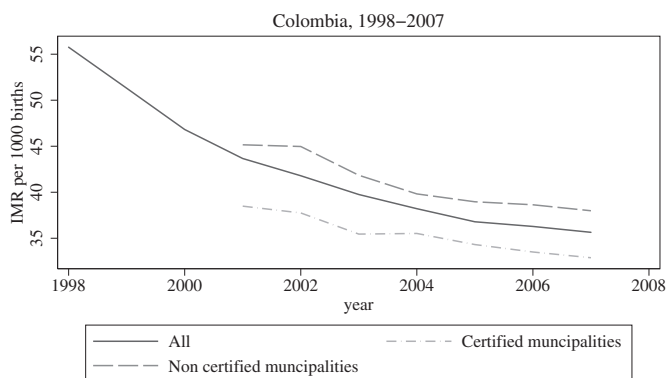


Fig. 2. Municipal infant mortality rate per 1000 births (IMR) by certified municipal status. Note: Authors' calculations from National Administrative Department of Statistics and Health Minister data.

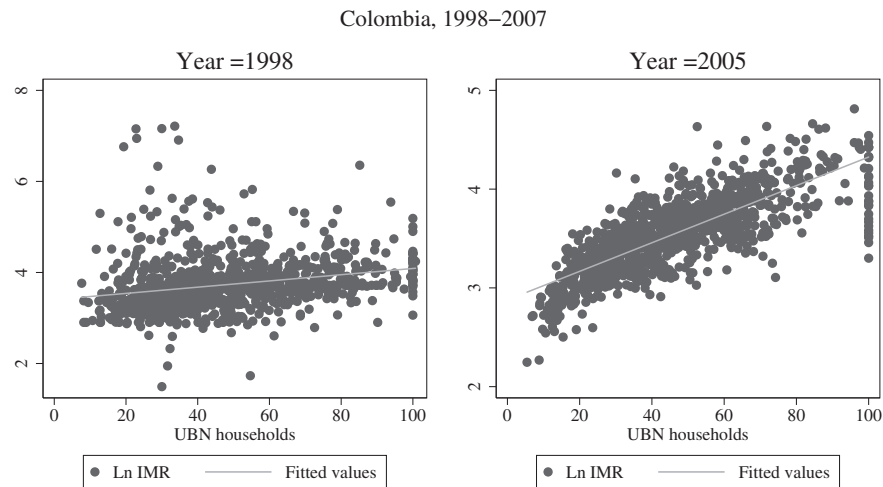


Fig. 3. Scatter plot of infant mortality rate per 1000 births (IMR) and percentage of households with unsatisfied needs (UBN) at municipal level. Note: Authors' calculations from National Administrative Department of Statistics.

according to local needs, thereby making allocation more efficient and leading to improvements in provision and health outcomes. In fiscal theory, Oates (1972) said that this notion of efficiency is mainly explained by geographic heterogeneity in preferences and needs. This heterogeneity can easily be observed in the Colombian context. Colombia is the fourth-largest country in South America and there are indeed enormous differences between its municipalities. These differences have cultural, economic, political, demographic, and geographic causes. Colombia has thousands of

municipalities; 25.7% of these are rural, while more than 74.3% of the population lives in the main cities (DANE, 2005). Income distribution is extremely unequal across the country, with a Gini coefficient of 58.5 (UNDP, 2009). Some municipalities show a persistence or resurgence of infectious and parasitic diseases such as malaria and tuberculosis, while others show an increasing incidence of chronic and degenerative diseases (Pinto & Hsiao, 2006). All of these differences show and give some clues about the heterogeneity across municipalities. That heterogeneity was seen

Table 4

Infant mortality rate (Ln) in Colombia 1998–2007 by municipal level of poverty. Results of unbalanced fixed effect model.

Variables	Non-poor municipalities ^a		Poor municipalities ^b	
	Coef. (1)	Coef. (2)	Coef. (3)	Coef. (4)
Fiscal decentralisation				
Locally controlled health expenditure as a proportion of total health expenditure (Ln)	−0.117 [0.048]**	−0.120 [0.048]**	−0.075 [0.035]**	−0.081 [0.037]**
Transfers from central government and institutional capacity				
Transfers from central government as a proportion of total health expenditure (Ln)	−0.105 [0.053]*	−0.138 [0.060]**	−0.058 [0.033]*	0.052 [0.037]
Accumulated years of municipality with certification status t		0.004 [0.012]		−0.017 [0.009]*
Transfers from central government as a proportion of total health expenditure (Ln) * Accumulated years of municipality with certification status t		0.025 [0.019]		−0.007 [0.016]
Local variables				
Households with unsatisfied basic needs (USB) (Ln)	0.025 [0.017]	0.033 [0.017]*	0.100 [0.020]***	0.107 [0.021]***
Municipality population (Ln)	−0.050 [0.020]**	−0.051 [0.019]***	−0.012 [0.018]	−0.012 [0.018]
Number of municipalities-years	5033	5009	4722	4631
Number of municipalities	506	506	481	481
R-squared	0.213	0.219	0.070	0.075
Breusch and Pagan Lagrangian multiplier test for random effects	8898.77***	8642.29***	10077.73***	9022.89***
Hausman test for difference in coefficients not systematic	Fixed effects 35.79***	Fixed effects 34.87***	Fixed effects 79.85***	Fixed effects 95.33***
Fisher test for panel unit root using an augmented	1142.56***	1100.73**	1391.29**	1211.89***
Dickey–Fuller test				

In 1993, 49.5% was the median value of the percentage of households with unsatisfied basic needs, out of 1030 municipalities with the available data on infant mortality rate per 1000 births that year. Of those municipalities, from 1998 to 2007, it was only possible to identify 984 municipalities and thus classify them as non-poor or poor.

*** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level; robust standard errors are in brackets; unbalanced fixed-effects regression controlling for municipality- and year-effects and also for a set of local variables such as the percentage of households with unsatisfied basic needs, the percentage of urban school enrolment, and municipality population; each health expenditure variable was lagged three-years and was measured as a logarithm; R^2 for within-countries estimator reported; the constant term was calculated but not reported.

The same results were found when we defined the poor and non-poor municipalities according to the first and fourth quartile defined by the percentage of households with unsatisfied basic needs at the municipal level in 1993. Models (1 and 2) were also estimated for the non-poor municipalities sample excluding the capital and the four most important and developed Colombian cities (Cali, Cartagena, Medellín, and Barranquilla), and the same results were obtained. All of these estimations, which are available upon request, were also robust.

^a denotes a sample of municipalities which showed a percentage of households with unsatisfied basic needs at least equal to 49.5%.

^b denotes a sample of municipalities which showed a percentage of households with unsatisfied basic needs higher than 49.5%.

as an argument in favour of decentralisation as a policy tool in Colombia and our results showed that this policy had a positive effect on health outcomes at local level.

The positive consequences of decentralisation in the Colombian context for infant mortality were consistent with results obtained in previous studies, which also looked at subnational health expenditure as a determinant of infant mortality (Cantarero & Pascual, 2008; Jiménez-Rubio, 2010). However, although we draw a similar conclusion here, our estimated effect of fiscal decentralisation was smaller (6%) than that shown by the other studies in a developed-country context. Jiménez-Rubio (2010) found that, on average, a 1% increase in health decentralisation was associated with a reduction of approximately 10% in infant mortality in Canada. Cantarero and Pascual (2008) also found a similar effect in OECD countries (11.1%). The different decentralisation size effect in Colombia may be mainly explained by socio-economic conditions in municipalities. For non-poor municipalities, the effect of decentralisation on the reduction of infant mortality per 1000 births was 12%, while for poor municipalities this effect was less (8%). This size effect of decentralisation in non-poor municipalities is quite close to what previous literature has shown.

However, in apparent contradiction with our results, Robalino et al. (2001) found that the effect of fiscal decentralisation on infant mortality rates was higher in poor-income countries than in middle-income countries. Comparisons with our study must be approached with caution, however, as two important differences exist with our empirical analysis. Firstly, we used a more accurate measure of fiscal decentralisation in the health sector than that used by Robalino et al. Indeed, locally controlled health expenditure as a proportion of total health expenditure better reflects the extent to which subnational expenditure allocated by local authorities takes place at the local level in the health sector than does an overall measure of fiscal decentralisation. Secondly, our analysis was based on a one-country analysis rather than on comparing the experience of different countries; this makes our estimation less vulnerable to heterogeneity between countries (Bonet, 2006; Costa-Font & Pons-Novell, 2007).

According to the literature, several reasons may explain why poor municipalities may fare worse than non-poor municipalities: they may have weaker institutions, higher levels of corruption, lower levels of community participation, or less ability to raise financial resources (Boadway & Shah, 2009; Enikolopov & Zhuravskaya, 2003; Saltman et al., 2006, chap. 1). All of these issues would reduce the potential effect on provision of decentralisation and, in turn, its ability to achieve better results in terms of health outcomes. To some extent, previous research supports such explanations.

In the Philippines, Azfar and Gurgur (2008) found that, regardless of the level of municipal income, corruption reduces the satisfaction levels with public clinics and child immunisation rates. However, unlike rich municipalities, poor and middle-income municipalities also reported more waiting at public clinics and more frequent denial of vaccines when corruption was widespread. In addition, Jütting et al. (2004) reviewed the relationship between decentralisation and poverty reduction: countries with non pro-poor impact were characterised by a literacy rate under 50%, poor infrastructure, and a bad corruption index perception. By contrast, countries with pro-poor impact had a very high literacy rate, sufficient government ability to carry out reforms, and a decentralisation process supported by transparency and community participation. This shows the importance of the country background in shaping the performance and scope of decentralisation. In Colombia, Sánchez (2006) showed that the health coverage of poor households grew faster in municipalities with a high level of institutional capacity than in municipalities with a low level of institutional

capacity. Regarding corruption, the municipal transparency index in 2008–2009 showed that the authorities of less developed municipalities in Colombia were at greater risk of suffering from corruption in local management than their counterparts in developed municipalities (Transparency for Colombia, 2010).

In our sample, non-poor municipalities included those municipalities that started the decentralisation process with a low percentage of households living in poverty. These municipalities also had more financial capacity to fund local health policies and a higher level of fiscal solvency, which may have affected the performance of decentralisation in the long run. Bossert et al. (2003) showed that wealthier Colombian municipalities spent much more of their local revenues per capita on the subnational health sector than the poorer municipalities: the wealthiest decile of municipalities spent 41.5 times more on the subnational health sector than the poorest decile of municipalities in 1995, although this difference was reduced to 11.9 in 1997. This is consistent with our results: non-poor municipalities still put more resources into the health system than poor ones. This situation poses a serious question of equity in fiscal terms, but also has a knock on effect on health outcomes. The effect of fiscal decentralisation on infant mortality was positive in both non-poor and poor municipalities, but was greater in the non-poor municipalities than in the poor ones. In line with this result, Montero-Granados and Juan de Dios Jiménez (2007) found that during the Spanish process of decentralising health care management, the provinces with the highest infant mortality at the start of the period improved more than the rest. However, in the end, the dispersion of infant mortality between provinces was greater than at the beginning of the period. Thus, the differences between the provinces were maintained.

In addition, our findings indicate the importance of examining the local management of health resources. Transfers from central government had a positive and small influence on decreasing infant mortality rates. In non-poor municipalities, this effect was only around 6%. It may be that poor municipalities have been having problems adjusting local budgets properly to population needs and achieving better results. In Colombia, the Pacific and Atlantic regions, the less developed regions, which exhibited the highest mortality rates, showed a reduction of vaccination coverage between 1990 and 2005 (Profamilia, 1990, 2005). Central government should design a type of transfer that generates incentives for local authorities to undertake specific provision of primary health services to reduce infant deaths. This type of transfer would encourage local authorities to be accountable to central government in the management of resources (Boadway & Shah, 2009). In addition, local incentives might be created to achieve national goals such as reducing infant mortality to a particular level.

Finally, according to the econometric analysis, we found that accumulated year of municipalities with certified status were not significant related to infant mortality. This unexpected result may be due to a policy design factor. According to Pinto, Carrasquilla, Gil, Collazos, and Rincón (2005), certification status in Colombia is a poor measure of effective institutional capacity and therefore, an inappropriate measure of the experience in efficient performing of management of health resources in the decentralised context. Pinto et al. (2005) found that 41.2% of certified municipalities analysed did not have a functional information system, 66.8% lacked a local health plan, 17.6% had not created a local health fund, and 61.5% did not have a local health bureau. Thus, certification may be a flawed indicator of effective institutional capacity at municipal level. Bossert and Mitchell (2011) pointed out that institutional capacities should involve resources such as adequacy of infrastructure or staff and processes such as whether

localities conducted monitoring and evaluation of the activities. Our results suggest that better certification evaluation and monitoring instruments are needed in order to ensure that certification status is only granted where appropriate.

This study measured the influence of decentralisation on infant mortality rates in Colombia. However, the results and the conclusions should be approached with some caution, besides what has been said so far. Firstly, in this study we have analysed only one aspect of the multiple and complex processes involved in decentralisation: fiscal allocation. Decentralisation in general is a complex process. It has been described as the transfer of power between political levels, between administrative levels, and from political to relatively independent institutional levels (Saltman et al., 2006, chap. 1). Further research should include other aspects of decentralisation, such as accountability and responsible governance. In addition, more reliable data on health is necessary in order to measure fiscal decentralisation more accurately, especially in developing countries. Secondly, although infant mortality is a widely used indicator of health status, it does not fully reflect the level of health in the population. Other health outcomes, such as maternal mortality and life expectancy, could also be analysed in the future. Thirdly, other local independent variables which measure local infrastructure and in particular primary health services should be analysed in order to reduce the unobservable factors that could affect the reduction of infant mortality rate at local level. And finally, we have assumed in this study that additional resources invested in the health sector have a positive effect on health insurance and thus improve health outcomes. Further studies could use other methodologies such as instrumental variables to analyse the relationship between decentralisation and infant mortality, since this method takes into account relevant intermediate factors such as health insurance.

Conclusion

This paper contributes to the empirical literature on fiscal decentralisation and infant mortality. The findings showed that subnational health resources had a positive effect on the decrease of infant mortality rates across the Colombian municipalities. However, this result was highly dependent on socio-economic conditions at municipal level. The results suggest that the benefits of fiscal decentralisation are greater in non-poor municipalities than in poor ones. Therefore, even when municipal governments know the needs of their communities, the level of local development is a key condition for reaching better results in improving infant mortality rates. The policy instrument used by Health Minister to determine the municipal institutional capacities in health sector needs to be revised.

Conflict of interest

The authors report no conflict of interest in relation to this study.

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References

- Asfaw, A., Froberg, K., James, K. S., & Jütting, J. (2007). Fiscal decentralisation and health outcomes: empirical evidence from rural India. *Journal of Developing Areas*, 41, 17–35.
- Azfar, O., & Gurgur, T. (2008). Does corruption affect health outcomes in the Philippines? *Economics of Governance*, 9, 197–244.
- Baron, G. (2007). *Cuentas de Salud de Colombia 1993–2003. El gasto nacional en salud y su financiamiento*, Ministerio de Protección Social, Programa de Apoyo a la Reforma de Salud–PARS. Bogotá: National Department of Planning Press.
- Boadway, R., & Shah, A. (2009). *Fiscal federalism*. Cambridge: Cambridge University Press.
- Bonet, J. (2006). Fiscal decentralisation and regional income disparities: evidence from Colombia experience. *The Annals of Regional Science*, 40, 661–676.
- Bossert, T., Larrañaga, O., Giedion, U., Arbelaez, J., & Brower, D. (2003). Decentralisation and equity of resource allocation: evidence from Colombia and Chile. *Bulletin of the World Health Organization*, 81(3), 95–100.
- Bossert, T., & Mitchell, A. (2011). Health sector decentralisation and local-decision making: decision space, institutional capacities and accountability in Pakistan. *Social Science & Medicine*, 72, 39–48.
- Cantarero, D., & Pascual, M. (2008). Analysing the impact of fiscal decentralisation on health outcomes: empirical evidence from Spain. *Applied Economics Letters*, 15, 109–111.
- Costa-Font, J., & Pons-Novell, J. (2007). Public health expenditure and spatial interactions in a decentralized national health system. *Health Economics*, 16, 291–306.
- DANE – National Administrative Department of Statistics. (2005). *La Mortalidad infantil en Colombia según censo de 1993. Estimaciones departamentales y municipales*. Bogotá: Departamento Administrativo Nacional de Estadística Press.
- DANE – National Administrative Department of Statistics. (1998). *La mortalidad infantil en Colombia según el censo de 1993. Estimaciones departamentales y municipales*, Estudios Censales, DANE Press.
- DNP – National Department of Planning. (2008). *Desempeño fiscal de los departamentos y municipios 2008*. Bogotá: National Department of Planning Press.
- Enikolopov, R., & Zhuravskaya, E. (2003). *Decentralisation and political institutions*. London: Centre for Economic Policy Research. Discussion paper, 3857.
- Faguet, J.-P. (2004). Does decentralisation increase government responsiveness to local needs? Evidence from Bolivia. *World Development*, 88, 867–893.
- Foster, A., & Rosenzweig, M. (2001). *Democratization, decentralization, and the distribution of local public goods in a poor rural economy*. Penn Institute for Economic Research. PIER working paper 01–056.
- Habibi, N., Huang, C., Miranda, D., Murillo, V., Ranis, G., Sarkar, M., et al. (2003). Decentralisation and human development in Argentina. *Journal of Human Development*, 4(1).
- Hutton, J. (2000). Indicators for monitoring health sector reform and the sector wide approach. In *Presentation at sector wide approach in health conference moving from policy to practice*. Amsterdam: Royal Tropical Institute.
- Jiménez-Rubio-Rubio, D. (2010). The impact of decentralisation of health services on health outcomes: evidence from Canada. *Applied Economics* 1–11, First published on 4 December (iFirst).
- Jütting, J., Kauffmann, C., Mc Donell, I., Osterrieder, H., Pinaud, N., & Wegner, L. (2004). *Decentralisation and poverty in developing countries: exploring the impact*. OECD Development Centre. Working paper, 236.
- Mello, L., & Barenstein, M. (2001). *Fiscal decentralisation and governance: a cross-country analysis*. International Monetary Fund Working paper, WP0171.
- Meloche, J.-P., Vaillancourt, F., & Yilmaz, S. (2004). *Decentralisation or fiscal autonomy? What does really matter? Effects on growth and public sector size in European transition countries*. World Bank Policy Research Working Paper 3254.
- Montero-Granados, R., & Juan de Dios Jiménez, J. (2007). Decentralisation and convergence in health among the provinces of Spain (1980–2001). *Social Science & Medicine*, 64, 1253–1264.
- Oates, E. (1972). *Fiscal federalism*. New York: Harcourt Brace Jovanovich.
- Pinto, D., Carrasquilla, G., Gil, A., Collazos, C., & Rincón, J. (2005). La certificación como indicador de descentralización en salud. *Revista Gerencia y políticas de salud*, 4, 149–262.
- Pinto, D., & Hsiao, W. (2006). Colombia: social health insurance with managed competition to improve health care delivery in social health insurance for developing countries. In W. Hsiao, & P. Shaw (Eds.) (pp. 105–132). The World Bank Institute.
- Plaza, B., Barona, A., & Hearst, N. (2001). Managed Competition for the poor or poorly managed competition? Lessons from the Colombia health reform experience. *Health Policy and Planning*, 16, 44–51.
- Profamilia. (1990). *Encuesta de prevalencia, demografía y salud – Encuesta nacional de demografía y salud*. Profamilia Press.
- Profamilia. (2005). *Salud sexual y reproductiva en Colombia – Encuesta nacional de demografía y salud*. Profamilia Press.
- Robalino, D., et al. (2001). *Does fiscal decentralisation improve health outcomes? Evidence from a cross-country analysis*. World Bank Policy Research Working Paper 2565.
- Rondinelli, D. A. (1983). *Decentralization in developing countries*. World Bank Research Working Paper, 581.

- Saltman, R., & Bankauskaite, V. (2006). Central issues in the decentralisation debate. In R. Salman, V. Bankauskaite, & K. Vrangbaek (Eds.), *Decentralisation in health care. European Observatory on Health System and Policies Series*,. New York: Mc-Graw-Hill.
- Sánchez, F. (2006). *Descentralización y progreso en el acceso a los servicios sociales de educación, salud y agua y alcantarillado*. CEDE-Andes University Working paper 2006-15.
- Transparency for Colombia. (2010). *Annual report 2009*. Transparency for Colombia Press.
- UNDP. (2009). *Human developing report 2009 overcoming barriers: Human mobility and development*. United Nations Development Programme (UNDP) Press.
- Verbeek, M. (2004). *A guide to modern econometrics*. Chichester: John Wiley and Sons Press.