

Decentralising Public Education: Are Cities Ready For It? New evidence from Colombia

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Abstract

In 2001 Colombia introduced important changes in the regulation of public service provision. Municipalities with more than 100 thousand inhabitants were made responsible of managing and providing public education on their territories. The inhabitant count was the only criterium used to decide whether a municipality could start administering local public education independently or was put under the authority of the larger region to which it belongs. I employ both a regression discontinuity design and fixed effects regression on a discontinuity sample to identify the effect of city-level autonomy over public education on pupil outcomes over a period of ten years after the reform. I find the effect of independent management of education to be heterogeneous across municipalities, depending on their level of development at the time of the reform. Effects on test scores are positive for municipalities characterized by higher pre-reform development measures, and instead negative in less developed municipalities. Magnitudes of the effects are sizable and show a trend reinforcing over time, increasing the gap between educational outcomes in high-developed versus low-developed municipalities.

1 Introduction

Decentralization of public service provision has been on top of policy agendas in numerous countries over the last decades. Education, health, public transport and the supply of energy, water and sanitation systems are the most frequently discussed areas. In developing countries the most common type of reform handles responsibilities down to the municipal level: recent examples are the experiences of Chile, Argentina, Bolivia, Brazil and Colombia in Latin America; India, Thailand, Vietnam and the Philippines in Southeast Asia; South Africa, Senegal, Ethiopia and Uganda in

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Africa; Ukraine, Serbia and Bulgaria in Eastern Europe. The arguments traditionally backing reforms that shift responsibilities to lower levels of government are expected increases in effectiveness and efficiency in the delivery of services¹, and better preference matching². Possible downsides of decentralizing public service provision are unpreparedness of local authorities for an efficient management their new duties, excessive increases in administrative and coordination costs, and corruption among local bureaucrats or local elites capturing resource transfers.

Among the multiple matters pertaining to the decentralization of public service provision, this analysis will be engaged mainly with the heterogeneity of impact that such reforms often exhibit. Two main dimensions of heterogeneity in reform outcomes are heterogeneity across places, i.e. between local areas on the territory, and heterogeneity across people within the same local area. Heterogeneity of outcomes across places arises as a direct consequence of the diversity in characteristics that may distinguish local areas from each other: different local institutions, local economic conditions and local culture lead to different management of the autonomy granted by decentralization processes. Heterogeneity of impacts across people within the same local area may occur as a consequence of preferences of local governors, power dynamics between political or ethnical majorities and minorities, or the presence of strong local elites.

Despite the increasing number of studies addressing decentralization, surveys of the literature find that the empirical evidence about the effect of decentralization on service delivery is weak, incomplete and often contradictory [Channa and Faguet, 2012]. Decentralization reforms are complex events that very rarely exhibit features which make identification of their effects an easy task. When countries implement decentralization reforms, these are typically applied to all local authorities belonging to the relevant level of government. Years afterwards, it is hard to distinguish between the effects of decentralization and the effects of other dynamics that have occurred in the country over the same period. In other cases, autonomy is given only to selected subgroups of local authorities: the selection is often based on “readiness criteria” that the local authority is required to meet - as Kurata and Ikemoto [2012] describe for the case of Thailand - or it is left to the discretion of the upper level of government - as in the case of India, analyzed in Singh [2008]. In those situations, selection bias hinders the identification of the effects of decentralization, as it becomes questionable whether any observed outcomes in terms of service delivery are due to the increased autonomy received or just to the normal evolution of those selected subgroups of local entities.

The above considerations allow to better appreciate the research value that the Colombian decentralization experience carries. Here the autonomy over the delivery of public education is given only to a subgroup of municipalities, but solely on the basis of a neat population cutoff - rather than on any quality measure that might be correlated with later outcomes. For municipalities located around

¹Usually through the channel of greater accountability and tighter monitoring of local authorities by local communities

²Local authorities are deemed better able to identify and serve needs which are specific to their territory

the cutoff, the assignment of autonomy over the management education is as good as random. Using municipal-level panel data on student test scores and on enrollment rates, I find across-place heterogeneity in the effects of the decentralization reform. Autonomous management of local education produced test score gains for municipalities which had above average development measures at the time of the reform, but test score losses for municipalities which had below average development.

2 Decentralization and Colombian Decentralization

Seminal theoretical work on the outcomes of decentralization features publications by Musgrave [1959] and Oates [1972], who focus on heterogeneity of preferences and informational advantage of local authorities, and study the conditions under which these lead to gains in allocative efficiency for local governments with respect to the central state. Accountability, monitoring and democratic elections are the drivers of decentralization outcomes in the strand exemplified by Crook and Manor [1998], Manor [1999] and Blair [2000]. Breton and Scott [1978] are among the initiators of the literature that focuses on the tradeoff that a decentralized system faces in terms of decreased signaling costs but increased administrative and organizational costs [Panizza, 2004]. Tiebout [1956] and Breton [1996] are leading references in the research on competition dynamics that decentralization triggers among local authorities, and on their subsequent impact on results in terms of service delivery.

Heterogeneity in the effects of decentralization is modeled by Bardhan and Mookherjee [2005, 2006], who show how the combination of strong local elites and weak local institutions implies decentralization to yield under-provision of services to the local poor. Diversity of impacts across places and people are discussed also by Kaiser [2006], and with a special focus on developing countries, by Juetting et al. [2005], who conclude failing to establish any clear link between decentralization and poverty reduction. In an empirical study looking at the U.S., Hammond and Tosun [2011] find that fiscal decentralization led to gains in employment and economic growth for metropolitan counties but insignificant to negative impacts for non-metropolitan ones. Galiani et al. [2008] find that transferring Argentinian schools from a central to a provincial management yielded positive results in terms of test scores, but only for schools located in non-poor municipalities.

Starting in the 1980s, Colombia has been undergoing a gradual decentralization process that has affected governance and administration, the fiscal structure, and the delivery of public services. We understand decentralization in the sense that many authors refer to as 'devolution', i.e. the transfer of both resources and decisional power from the central government to more local levels of governance. Relevant mileposts over the last two decades were the new 1991 Constitution, which had a strong decentralizing flavor and triggered a wave of enactment laws and regulations in the subsequent years, and the reform in 2001, which redefined responsibilities and funding for the delivery of public services. Various authors have looked at the outcomes of these processes, some in a qualitative and some in

a quantitative fashion. Focusing on education, Borjas and Acosta [2000], Vergara and Simpson [2001] and Caballero [2006] present comprehensive studies on the dynamics and general outcomes of decentralizing the education system over the last three decades. Educational outcomes of the 2001 reform are being considered in the Central Bank report by Lonzano et al. [2007], who conclude that the post-reform years have witnessed progress in attendance rates but disappointing results in terms of quality and efficiency. Cortés [2010] uses enrollment data up to 2006 and compares the municipalities who gained autonomy over the service to all other municipalities, finding that the former significantly increased enrollments of publicly subsidized pupils into private schools. Faguet and Sanchez [2008, 2014] look at municipalities’ balance sheet data and construct aggregate measures of decentralization expressing their dependence on central government transfers, and find higher decentralization measures to be associated with higher expenditure on education and positive effects on public school enrollment rates.

3 The 2001 Reform

3.1 Reform context and motivations

Colombia is currently structured into local authorities as follows: there are 32 departments, which are the equivalent of “regions” or “states” in other countries; 1,118 municipalities, each belonging to one department; 4 special districts, whose nature is mixed between a department and a municipality. All local authorities are governed by locally elected officials (governors, mayors and their councils) and have autonomy over the management of a wide range of matters, within the guidelines defined by national laws. Around 46% of total public expenditure is spent by subnational local authorities, making of Colombia the Latin American country with the third most decentralized spending structure [Toro, 2006]. The taxation system is instead quite centralized: 82% of total revenues is collected by the central government, around 6% by departments and 12% by municipalities. It follows that most of the resources that local authorities spend on public services are transferred from the central government. Looking at education expenditure, central government transfers account for around 90% of the total, and the remaining 10% is contributed by departments’ and municipalities’ own resources in approximately equal proportion (Borjas and Acosta, 2000, p.6; Iregui B. et al., 2006, p.31; Santa Maria S. et al., 2009, pp.19-20).

Up to the reform in 2001, it was Law 60/1993 that regulated competencies over the delivery of public services and the distribution of the necessary resources. Under that regime, departments were receiving and administering around 80% of the transfers for education (*Situado Fiscal*), and the remaining 20% was addressed to municipalities (“*Participaciones en los ingresos corrientes de la Nación*”)³ [DNP, 2002, p.16; Borjas and Acosta, 2000, p.6]. The legal framework in place at that

³The shares were subject to yearly variations, as the transfers were computed as percentages of different types of

time put both departments and municipalities in charge of the education service, and both were entitled to hire personnel and invest in infrastructure and equipment⁴. As a result, the division of responsibilities over the management of public education was far from transparent; in fact, one of the goals of the 2001 reform was to eliminate such responsibility overlaps, for the sake of efficiency and accountability⁵. Being the direct recipients of most of the resources for education, departments had a relatively strong leverage on the education sector. Teachers' salaries make up for approximately 87% of Colombian expenditure on education⁶, and departments had the final word on decisions regarding 85-90% of all public school teachers, as these were on departmental payrolls [Corte Constitucional, 1997, par.16]. The most relevant decisions about school staff were hiring and allocation across municipalities⁷. Municipalities were then responsible for allocating teachers across schools within their territory, and for the hiring the remaining 10-15% that was not on departmental payrolls [Gómez et al., 2001].

3.2 Reform content

In December 2001, Law 715/2001 replaced Law 60/1993 in the regulation of responsibilities and fund transfers⁸ to local authorities for the delivery of health, education and other public services. Both before and after the reform, transfers are service-specific and have separate accounting, i.e. transfers for health cannot be used to finance education and vice versa, and are not pooled together with other incomes of the local authority.

In the sector of education, the concept of "certification" was introduced already by Law 60/1993. Local authorities which are certified in education are in charge of the management and the delivery of the public education service, for the levels of preschool, primary and secondary⁹. Over the period 1993-2001, departments and districts were in theory the only certified entities¹⁰; in practice though, national revenues.

⁴Law 60 / 1993 (distributing competencies across levels of government and assigning resources accordingly), Law 115 / 1994 (the 'comprehensive education act'), and respective follow-up decrees.

⁵For the official document motivating the reform, see: "Exposición de motivos 715 de 2001 Nivel Nacional", Congreso de Colombia, Gaceta del Congreso 294 de 2000. For further discussions of this matter see among others Sarmiento and Vargas, 1997; Alesina et al. [2000]; Borjas and Acosta [2000] and Vergara and Simpson [2001]. Other aims driving the reform were enhancing decentralization as a way to improve efficiency in the use of resources, and to stopping transfers from being highly dependent on the general economic conditions and thus excessively volatile.

⁶Computation by the author, based on the data in DDTS [2004] and DNP [2002]; confirmed by figures in Corte Constitucional [1997].

⁷"Exposición de motivos 115 de 1994 Nivel Nacional", Congreso de Colombia (Feb 1994)

⁸From 2001 onwards, the amount of transfers has been based on the number of pupils effectively and potentially served by the local authority. The 1993 formulas were mainly considering poverty indexes, and to some degree the local authorities' performance and efficiency.

⁹This is, for the 11 years of schooling that children attend from the age of 5-6 onwards. The first 9 years are compulsory, the last 2 are eligible.

¹⁰And the municipalities of Armenia and Pasto, who acquired certification in 1999 and 2000, and are excluded

responsibilities were shared with municipalities and unclearly allocated - as described in the previous subsection. The 2001 reform re-established and reinforced the concept of certification, prescribing each certified local authority to be the only responsible for the public education service on its territory, solving the problem of overlapping responsibilities and funding. As the reform also aimed at enhancing decentralization, it set grounds for a fully municipalized delivery of the main public services. It thus established that certification in education had to be automatically attributed to all municipalities that in 2002 had more than 100 thousand inhabitants. Certification in education was this way given to 40 municipalities in 2002. These cities account for around one third of Colombia's population and pupil share; their size ranges from 105 thousand to over 2 million inhabitants. The law also provided for smaller municipalities to achieve certification, but on condition that they satisfy a list of attributes proving their readiness to take over the management of the service. In practice, no other municipality was certified up to 2008. In 2008 two further municipalities acquired certification, and fourteen more did in 2010. In this second wave of certifications, the award of certification is likely to be correlated with municipality characteristics other than population. The main results are robust to excluding the latest years of data; these specifications are shown in Table 8 in Section 10.2.4 in the Appendix.

From 2002 onwards, the unchallenged authorities over the public education service were certified municipalities for their own territory, and departments for all non-certified municipalities within their boundaries. Certified municipalities and departments are the direct recipients of all central government transfers necessary to run the service¹¹, following formulas based on the number of pupils to be served.

The reform provided for a transition period of two years (2002 and 2003), during which certified local authorities took over the school infrastructure, started the effective management of the service, and reorganized the staffing plans of the respective territories. During these two years, transfers to certified authorities amounted to the 'effective service cost' as in 2001, and from 2004 onwards the new transfer system became operational.

Both before and after the reform, teacher salaries are set by the national government, and school curricula are set by each school within national guidelines.

3.3 The inhabitant cutoff

The figures that were taken as reference by the legislator at the time of the reform were the population projections that the National Statistics Office (DANE) had computed after the 1993 census. That

¹¹Non-certified municipalities actually do receive a small amount of central government transfers ("*Recursos SGP para calidad - Matricula Oficial*"). These represent around 4.4% of the education expenditure (DNP, 2013a, a and 2013b, b) and the municipality's discretion over their use is limited, as the law provides a closed list of their possible specific destinations; they cannot be used towards personnel salaries (Art. 16 Law 715/2001).

is, certification was assigned to those municipalities that according to the projections computed in 1993 were exceeding 100 thousand inhabitants in 2002. Throughout the analysis, the 'municipal population' referred to will be the one stated in those projections and used to assign certification. The cutoff was sharply implemented, and no exceptions were made in either direction. Moreover it is useful to clarify that beyond education, none of the other public service sectors that were reformed in 2001 made use of this inhabitant cutoff.

It is reasonable to ask why the population threshold was set at 100 thousand inhabitants, and whether the same cutoff is also used for purposes other than certification in education. Every fiscal year Colombian municipalities are classified into one of 7 categories¹², according to their number of inhabitants and their current revenues; 100 thousand inhabitants is the lower bound of the 'First' category. The reform thus adopted one of the thresholds traditionally existing in the legal framework. The yearly categorization is used for setting limits to salaries of the mayor, of council members and administrative staff, limits to general administrative expenditures, and for determining entitlement to special transfers from central government (the latter for categories 'Fourth' to 'Sixth' only). None of these limits change considerably between categories 'First' and 'Second', and in any case they do not raise particular worries in terms of interfering with public education management or expected educational outcomes. To further appease potential worries in this context, Panels i) and j) in Figure 6 show continuity of municipal transparency and accountability indexes across the 100 thousand cutoff.

4 Data

Educational Outcomes

The analysis in the following sections seeks to measure the impact of the 2001 reform on educational outcomes at municipal level. Outcomes under investigation are student test scores and school enrollment rates.

Student test scores are a measure of quality of the education received. Colombia has a long running tradition of standardized tests being administered to students at various school levels; the government agency in charge of conducting and assessing the tests across the whole country is called ICFES. The most complete test score data refers to the Saber11 examination, which is administered to all students completing the two years of optional upper secondary education, which follow compulsory five years of primary and four years of lower secondary education. Saber11 is widely

¹²Law 136 / 1994 and Law 617 / 2000. The seven categories and their relative inhabitant cutoffs are: Special (500,001 or above), First (100,001 to 500,000), Second (50,001 to 100,000), Third (30,001 to 50,000), Fourth (20,001 to 30,000), Fifth (10,001 to 20,000) and Sixth (10,000 or below).

accepted as the reference examination to evaluate the quality of Colombian secondary education; its results are used to categorize schools into one of seven quality levels each year¹³, and these rankings are widely published and source of prestige for schools. Saber11 evaluates a range of school subjects; test scores range from 0 to 100 in each subject and are standardized by subject at the national level, to a mean of 50 and a standard deviation of 10. This is, each student's score is informative about his/her position relative to the national average in that subject. Individual-level Saber11 test scores are made available by ICFES for the years 2000 to 2012, with information about the school and municipality to which each student belongs.

Municipal Development Measures

The development level of Colombian municipalities is being evaluated periodically, data being collected by the National Statistics Office (DANE) and the corresponding summative indicators worked out by the National Planning Department (DNP). Among the most informative and widely used indicators we find the Municipal Development Index (hereafter MDI¹⁴). The MDI ranges from 0 to 100 and expresses a composite measure of municipal development; it considers 'social' or 'life quality' variables such as coverage of energy, water and sewerage systems, literacy rates and poverty ratios, and 'financial status' variables such as per capita tax income and public spending, and dependency on central government transfers; the higher index value, the better. Municipalities which obtained certification in 2002 had 2001-MDI values ranging from 28 to 70 - and as can be seen in Figures 1 and 5, size and development level are not highly correlated ($\rho = 0.22$). The analysis developed in the following sections aims at verifying the theoretical prior of autonomy in service provision having heterogeneous impacts on municipalities, depending on their level of development.

The Appendix shows results obtained using a different and also well established development indicator, the Unsatisfied Basic Needs indicator (hereafter UBN¹⁵). The UBN indicator ranges from 0 to 100 and expresses the percentage of municipal inhabitants experiencing at least one 'unsatisfied basic need' among the categories of living standards, access to education and economic situation of the household; the lower index value, the better. The Colombian UBN index is computed at every general census; the most recent pre-reform measurement occurred in 1993; the UBN of later certified municipalities then ranged from 9 to 71. Results obtained using the UBN indicator are consistent both qualitatively and quantitatively with those obtained using the MDI index.

¹³"Clasificación de planteles" ICFES. Levels are "Very superior"; "Superior"; "High"; "Medium"; "Low"; "Inferior"; "Very inferior".

¹⁴Translation from the original *Índice de Desarrollo Municipal (IDM)*. Data on the index is provided for public use by the Colombian National Planning Department (DNP - *Departamento Nacional de Planeación*).

¹⁵Translation from the original *Índice de Necesidades Básicas Insatisfechas (NBI)*. Data on the index is provided for public use by the Colombian National Planning Department (DNP - *Departamento Nacional de Planeación*).

5 Identification

5.1 Sharp Regression Discontinuity Design

The fact that in 2001 certification was assigned solely on the basis of the 100 thousand municipal population cutoff sets the conditions for a sharp regression discontinuity design¹⁶. Units of observation i are municipalities, the binary treatment is certification status C_i , and the running variable is population P_i , so that $C_i = \mathbb{1}\{P_i > c\}$ with $c = 100\,000$ being the discontinuity point. Denote $Y_i(1)$ and $Y_i(0)$ the potential educational outcomes for municipality i with and without certification respectively. We aim at estimating the average causal effect of the certification treatment at the discontinuity point: $\tau = \mathbb{E}[Y_i(1) - Y_i(0) | P_i = c] = \mathbb{E}[Y_i(1) | P_i = c] - \mathbb{E}[Y_i(0) | P_i = c]$. Given that C_i is assigned only based on population P_i , the unconfoundedness assumption is satisfied: $Y_i(0), Y_i(1) \perp C_i | P_i$ - i.e. treatment is as good as randomly assigned, conditional on population. By construction though, there is no overlap in treatment status for any values of P_i - so we do not observe both $Y_i(0)$ and $Y_i(1)$ at $P_i = c$. Thus there is need for extrapolation, and we rely on observing units with values of P_i close to c . For this strategy to be valid, we need to assume smoothness of the conditional expectation functions of the outcomes: $\mathbb{E}[Y_i(0) | P_i = p]$ and $\mathbb{E}[Y_i(1) | P_i = p]$ are continuous in p , or at least at $p = c$. Translating this assumption into our setup, we need to assume that the observed and unobserved determinants of educational outcomes are related to municipal population in a smooth way, and do not exhibit discontinuities at $P_i = 100\,000$. Section 3.3 has reviewed some descriptive evidence supporting the judgment that there are no reasons for which expected educational outcomes, or any other municipal characteristic, would change discontinuously across the 100 thousand cutoff. To further support, panels in Figure 6 show the distribution against population of various municipal characteristics, including pre-reform test scores, municipal development measures and municipal financial indicators.

When unconfoundedness and continuity across the threshold are satisfied, one can estimate the model

$$Y_i = \alpha + \tau^{RD} C_i + f(P_i) + \epsilon_i \quad (1)$$

where $f(P_i)$ is approximated by a higher order polynomial in P_i , and interpret τ^{RD} as the average causal effect of certification in education. Section 6 presents the estimation results for all levels of municipal development, and by different development categories. The interaction between municipal development and certification is alternatively captured by augmenting the model with a linear interaction term, obtaining

$$Y_i = \alpha + \tau_0^{RD} C_i + \tau_1^{RD} C_i * D_i + \beta D_i + f(P_i) + \epsilon_i \quad (2)$$

¹⁶The subsequent methodological summary draws on the excellent outline by Imbens and Lemieux [2008]

where $\tau_0^{RD} + \tau_1^{RD} D_i$ can be interpreted as the average treatment effect of certification at development level D_i ; estimation results of this specification are also presented in Section 6.

5.2 Fixed Effect Regression on a Discontinuity Sample

This section presents an alternative method for estimating the average causal treatment effect of certification in education. This strategy exploits the time dimension of the reform, looking at the change in educational outcomes in municipalities between the pre-reform and the post-reform period. The sample is limited to municipalities with a number of inhabitants close to the certification cutoff, both from the left and from the right. Following Angrist and Lavy [1999], I refer to this as our ‘discontinuity sample’. Given that certification in education was assigned solely based on whether the 2002 population projections trespassed the 100 thousand threshold, for municipalities in the discontinuity sample the certification treatment C_i is as good as randomly assigned. Thus we can run a linear regression of educational outcomes Y_{it} on certification status C_{it} , which takes value 1 in years from 2002 onwards for municipalities who obtained certification, and 0 otherwise. We also allow for vectors of municipality fixed effects \mathbf{M}_i and of time fixed effects \mathbf{T}_t :

$$Y_{it} = \alpha + \tau^{LLR} C_{it} + \gamma \mathbf{M}_i + \delta \mathbf{T}_t + \epsilon_{it} \quad (3)$$

where the effect of certification is captured by τ^{LLR} . For the main specification in the empirical analysis I use municipalities between 80 thousand and 130 thousand inhabitants - which results in a sample of thirty cities, eleven of which acquired certification in 2002 and nineteen did not¹⁷, and whose population counts and development indices are illustrated in Figure 1 with dark bars and light bars respectively¹⁸. Table 1 shows some relevant summary statistics separately for certified and non-certified municipalities, and highlights the similarity of the two groups in terms of pre-reform characteristics - including pre-reform test score levels. Table 5 in Section 6 shows additional regression results supporting the absence of differences across the certification threshold.

¹⁷Results are robust to extending the sample into both directions; regressions on different samples are presented in Table ?? in the Appendix.

¹⁸Figure 5 in the Appendix shows the two distributions for a wider range of municipalities.

Figure 1: Population and MDI distribution of the 30 municipalities around the inhabitant cutoff

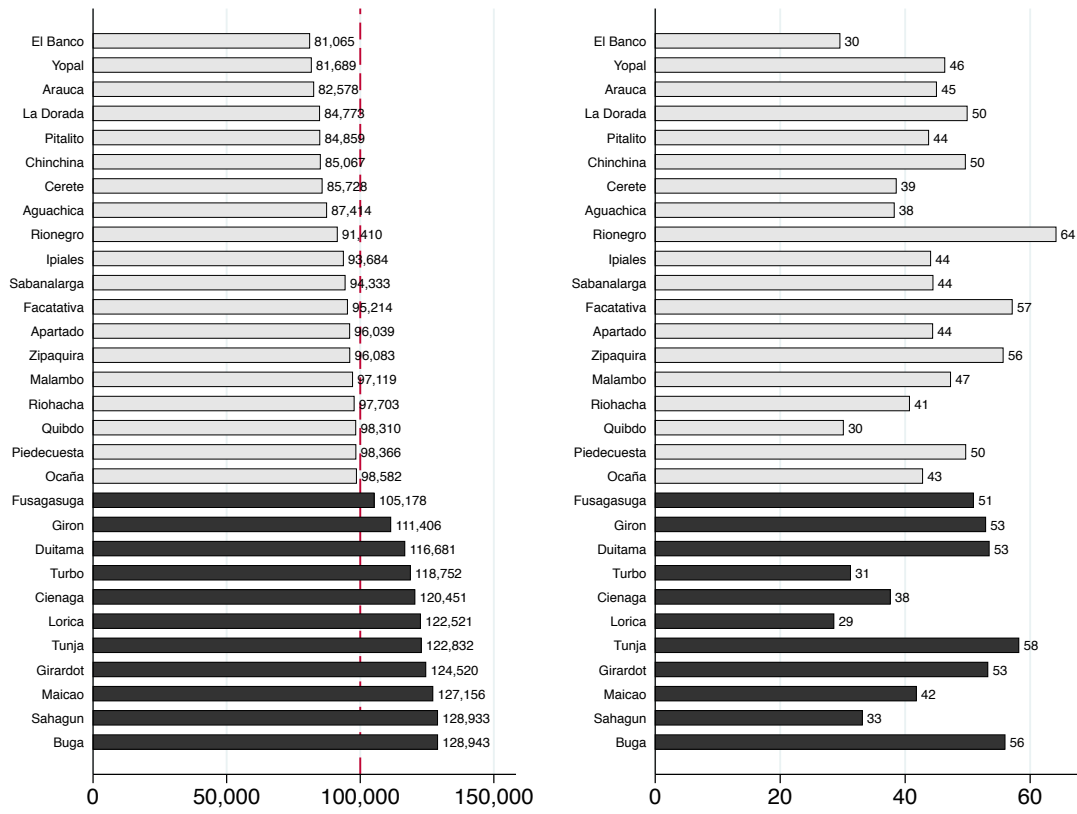


Table 1: Municipalities in the discontinuity sample

	Certified (N=11)	Non certified (N=19)	Difference	
Population in 1992	99,998	73,182	26,816	***(1,820)
Population in 2002	120,670	91,043	29,627	***(692)
Population in 2012	127,756	112,305	15,451	***(3,705)
Municipal Development Index (MDI) 2001	40.99	40.59	0.40	(1.92)
Unsatisfied Basic Needs indicator (UBN) 1993	45.18	45.34	-0.16	(0.96)
Saber 11 Math score 2001	40.38	40.45	-0.07	(0.39)
Saber 11 Language score 2001	45.27	45.33	-0.06	(0.62)
Public primary school gross enrollment rates 2001	0.67	0.67	-0.00	(0.06)
Public secondary school gross enrollment rates 2001	0.61	0.61	0.00	(0.05)

Standard error of mean difference in parentheses; *p<0.10 **p<0.05 ***p<0.01

The 30 cities in the discontinuity sample account for about 8.35% of the student population enrolled in primary and secondary school in 2012: 5% in the 19 non-certified municipalities and 3.35% in the 11 certified ones¹⁹.

Once again the main interest lies in identifying an effect of certification in education being potentially heterogeneous by level of municipal development. Heterogeneous effects are allowed for through a model specification featuring an interaction term between certification status C_{it} and development measure D_i , obtaining

$$Y_{it} = \alpha + \tau_0^{LLR} C_{it} + \tau_1^{LLR} D_i + \gamma \mathbf{M}_i + \delta \mathbf{T}_t + \epsilon_{it} \quad (4)$$

where the effect of certification at development level D_i will be given by the estimates of $\tau_0^{RD} + \tau_1^{RD} D_i$. Section 6 shows results of this local linear regression approach.

¹⁹Calculations by the author, based on enrollment data provided by MEN (Ministry of Education).

6 Results

6.1 Regression Discontinuity results

In Table 2, Columns (1) of panels (2a) and (2b) report the outcome of model (1). In all cases, the sample has been trimmed so to exclude from the analysis municipalities of special sizes, namely those below 10 thousand and above 500 thousand inhabitants (municipal categories “Special” and “Sixth” - see footnote 12). The average effect of certification in education on municipal test scores is estimated being close to zero. Columns (2) to (6) of the two panels explore intra-sample heterogeneities in the effect, with respect to the level of municipal development as measured by the MDI 2001²⁰. Columns (2) to (5) show results of model (1) applied to municipalities of different development levels: respectively, those characterized by top 25%, top 50%, bottom 50% and bottom 25% values from our development distribution of interest. The pattern that is uncovered suggests the impact of certification being negative on test scores of less developed municipalities, and positive on the scores of more developed ones, consistently across the two subjects. The magnitudes of the effects are sizable, decreasing municipal average scores by up to 1.5 points in the less developed quartile, and raising it by up to 2 points in the most developed quartile. These convert into -0.15 and +0.2 student standard deviations in scores respectively. The three panels in the first column of Figure 2 depicts these estimation results graphically, focusing on the area of the discontinuity.

Columns (6) in the two panels of Table 2 show the estimation of model (2), where certification status is linearly interacted with the development percentile to which each municipality belongs, as an alternative way to capture heterogeneity in the effect. This second estimation approach confirms the pattern previously emerged: the effect of certification is increasing in MDI values, starting negative for low MDI values and becoming positive at higher ones.

6.1.1 Allowing the reform to consolidate over time

As we would expect the effect of the reform to mature over time, here I look at years further away from the reform date . As mentioned in section 3.2, the first two reform years, 2002 and 2003, were labeled as the ‘transition period’ - in which the newly certified municipalities had just started

²⁰The relevant MDI distribution is the one pertaining to municipalities which obtained certification in 2002; figure 4 shows MDI densities for certified and non-certified municipalities.

Table 2: Certification on Saber 11 test scores - by Municipal Development Index '01

[Regression Discontinuity Estimation]

(a) Mathematics

	(1) All	(2) Bottom 25%	(3) Bottom 50%	(4) Top 50%	(5) Top 25%	(6) Interaction
Certified	0.167 (0.63)	-1.580 (0.99)	0.399 (0.94)	0.729 (0.87)	2.201** (0.86)	-2.542*** (0.56)
Certif.*MDI'01 perc.						0.037*** (0.01)
MDI'01 percentile						0.023*** (0.00)
.						
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes
N	7,572	6,536	7,100	472	275	7,561
R-sq.	0.013	0.003	0.003	0.011	0.050	0.084

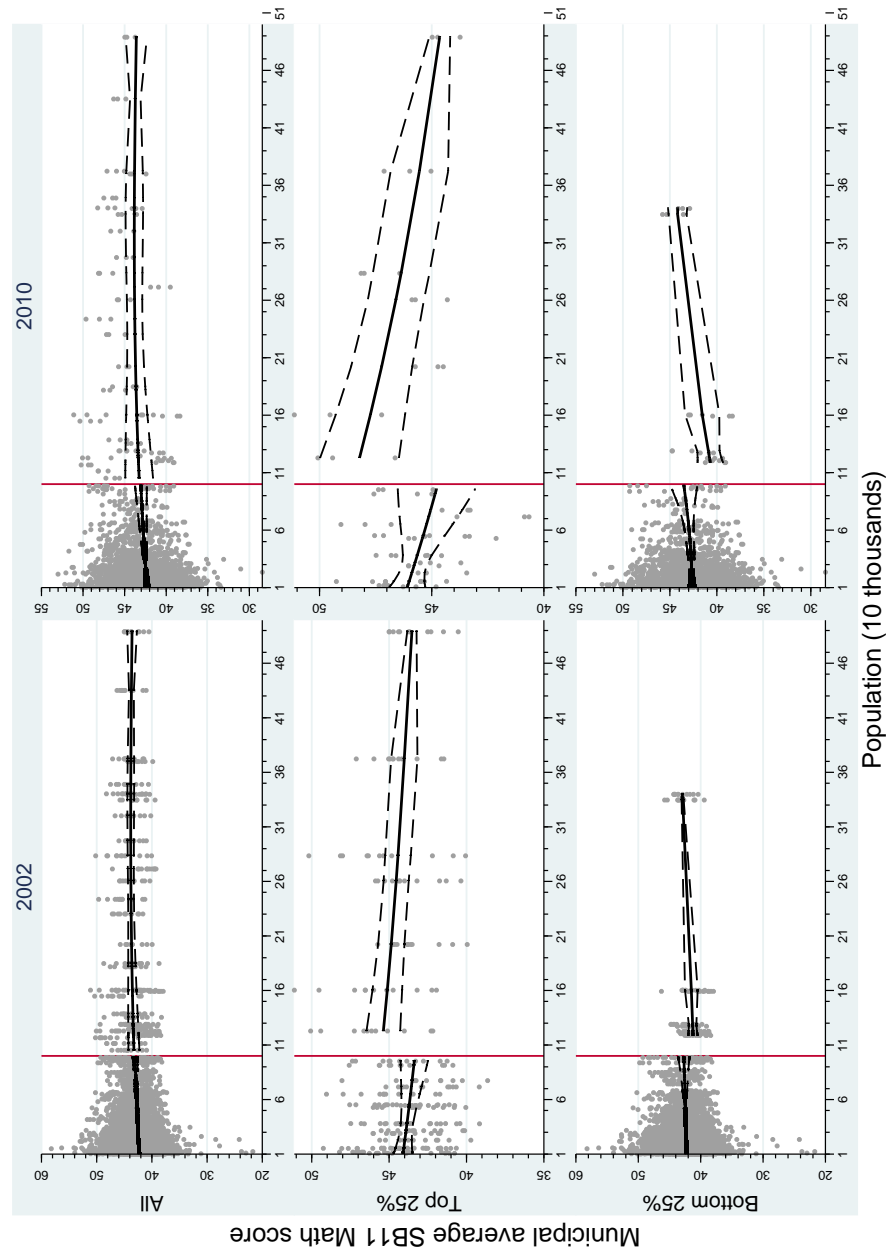
(b) Spanish Language

	(1) All	(2) Bottom 25%	(3) Bottom 50%	(4) Top 50%	(5) Top 25%	(6) Interaction
Certified	0.073 (0.66)	-1.553 (1.00)	0.319 (0.94)	0.521 (0.90)	1.810 (1.14)	-2.428*** (0.66)
Certif.*MDI'01 perc.						0.035*** (0.01)
MDI'01 percentile						0.031*** (0.00)
.						
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes
N	7,572	6,536	7,100	472	275	7,561
R-sq.	0.018	0.003	0.004	0.011	0.035	0.123

Standard errors clustered by municipality in parentheses

* p<.10 ** p<.05 *** p<.01

Figure 2: Certification on Saber 11 Math scores - Graphical results



Municipal averages of Saber 11 Math scores against population. Left column for years 2002 and onwards, right column for years 2010 and onwards. Solid lines are predicted values of Math scores, dashed lines are 95% confidence intervals on the prediction.

taking over the service and were organizing their activities. Moreover, different cohorts of test takers have different lengths of exposure to the reform. The 2007 test cohort was the first one exposed to the reform over their full 5-year high school cycle, while earlier test cohorts have had partial exposure only. Table 3 repeats the estimation of models (1) and (2) on years from 2004, 2007 and 2010 onwards. We can see that the heterogeneous pattern of the certification effect becomes clearer as time passes, with the slope on the interaction between certification and level of development becoming steeper at each period. Figure 3 illustrates this dynamic, graphing marginal effects of certification on mathematics test scores by MDI percentile for periods from 2002, 2004, 2007 and 2010 onwards - as estimated respectively in column (6) of Table (2)(2a) and columns (1)-(3) of Table (3)(3c). The emerging pattern implies that the gap between test scores in low-developed and high-developed municipalities widens over time as a consequence of the autonomous management of education. Looking at the 8th, 9th and 10th year after the reform (years 2010 to 2012), the impact of autonomous management of education has intensified to reach about -3 points on the Math average of the lowest-developed municipalities and +3 points on the average of the most developed ones. These correspond to changes of negative and positive 0.3 student standard deviations respectively, very sizable effects. Again the effects on Language scores are smaller and less significant, in line with findings in literature. The three panels in the second column of Figure 2 show estimation results on Math scores for years 2010 and onwards.

6.2 Fixed effects regression results

This subsection discusses the results obtained through our second identification strategy, the “local linear regression” identification described in Section 5.2. Table 4 shows the estimation results of the basic model (3) and of the specification that allows for development-heterogeneous effects (4), Panel 4a for the Mathematics test and Panel 4b for the Spanish Language test. The sample is composed of the 30 municipalities around the inhabitant cutoff: 19 non-certified ones with more than 80 thousand inhabitants and 11 certified ones with less than 130 thousand inhabitants. The outcome variables are municipal test score averages for the two subjects for the years 2000 to 2012. The first two columns of each panel refer to the basic model, showing OLS and municipality fixed effects estimations. The third and fourth column show OLS and fixed effects estimations of the main specification, using the MDI 2001 as a proxy for municipal development. The fifth and sixth columns use the UBN 1993 as municipal development proxy. In the basic model the effect of certification

Table 3: Certification on Saber 11 test scores - progress over time

[Regression Discontinuity Estimation]

(a) Top 25% MDI '01

	Mathematics			Spanish Language		
	(1) Post 2004	(2) Post 2007	(3) Post 2010	(4) Post 2004	(5) Post 2007	(6) Post 2010
Certified	2.366** (0.92)	3.004*** (1.06)	3.802** (1.52)	1.636 (1.09)	1.359 (1.04)	1.922 (1.29)
.						
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes
N	225	150	75	225	150	75
R-sq.	0.069	0.137	0.199	0.038	0.126	0.137

(b) Bottom 25% MDI '01

	Mathematics			Spanish Language		
	(1) Post 2004	(2) Post 2007	(3) Post 2010	(4) Post 2004	(5) Post 2007	(6) Post 2010
Certified	-1.800 (1.12)	-2.233* (1.29)	-3.170** (1.60)	-1.468 (1.02)	-1.607 (1.06)	-2.030* (1.12)
.						
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes
N	5,344	3,609	1,809	5,344	3,609	1,809
R-sq.	0.003	0.005	0.007	0.003	0.004	0.007

(c) Interaction with MDI '01 percentiles

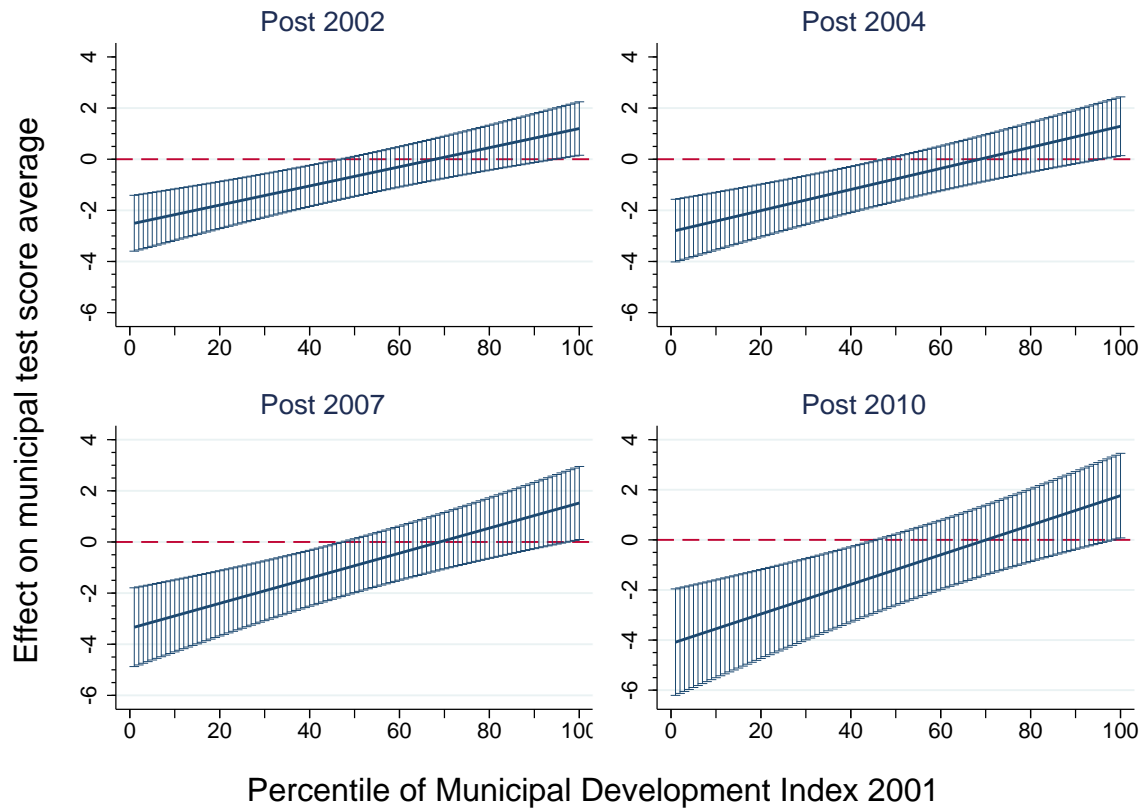
	Mathematics			Spanish Language		
	(1) Post 2004	(2) Post 2007	(3) Post 2010	(4) Post 2004	(5) Post 2007	(6) Post 2010
Certified	-2.833*** (0.63)	-3.382*** (0.79)	-4.142*** (1.09)	-2.354*** (0.68)	-2.549*** (0.68)	-3.190*** (0.83)
Certif.*MDI'01 perc.	0.041*** (0.01)	0.049*** (0.01)	0.059*** (0.01)	0.035*** (0.01)	0.038*** (0.01)	0.044*** (0.01)
MDI'01 percentile	0.025*** (0.00)	0.030*** (0.00)	0.040*** (0.00)	0.031*** (0.00)	0.029*** (0.00)	0.037*** (0.00)
.						
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes
N	6,181	4,172	2,091	6,181	4,172	2,091
R-sq.	0.091	0.125	0.197	0.115	0.162	0.246

Standard errors clustered by municipality in parentheses

* p<.10 ** p<.05 *** p<.01

Figure 3: Marginal effects of Certification on Saber 11 Math scores

[Regression Discontinuity Estimation]



Average marginal effects of Certification on municipal average Saber 11 Math score plotted against the 2001 MDI percentile to which the municipality belonged. The data underlying each panel includes the year in the panel title and the subsequent ones until 2012. 95% confidence bands shaded.

is estimated close to zero and statistically not significant. Once we include the interaction with municipal development indexes, the pattern of the effect of certification becomes clear²¹. Confirming our regression discontinuity results, estimations in this section show heterogeneity in the effect of the reform, indicating that autonomous management of local education yielded negative results for less developed municipalities and positive results for more developed ones. The effects are stronger and more precisely estimated for Mathematics scores than for Language, a result often found in literature. Also quantitatively the results from the Local Linear Regression technique match the ones from the Regression Discontinuity estimation. For municipalities characterized by above average municipal development indicators, gains in test scores quantify in up to 1.5 points - corresponding to 0.15 of a student standard deviation or 0.6 of a municipal standard deviation. For municipalities with a development score below average, average test score losses range up to 1.34 - corresponding to around 0.13 of a student standard deviation or 0.53 of a municipal standard deviation.

6.2.1 Falsification test and common pre-reform trend

Table 5 serves the purpose of conveying further credibility to the results presented in the previous sections. In particular, it aims at lessening the worry that the identified effects might reflect patterns that are not a result of the reform and instead exist independently of it. Panel 5a shows a falsification test in which the RD methodology of table 2 is applied to the two available pre-reform years, 2000 and 2001, instead of the post-reform years. In columns (1) to (4) and (6) to (9), where different parts of the development distribution are considered, absence of statistical significance and of any meaningful pattern in coefficient sizes speak against the existence of pre-reform differences in test score levels between later-certified and later-non-certified municipalities. Panel 5b performs the same exercise on pre-reform trends in scores, taking as an outcome variable the difference in scores between 2001 and 2000. Again the results suggest that in the years preceding the reform the trend in scores was not differing between the two groups of municipalities.

²¹See Stevens [1999] and Brambor et al. [2005] for valuable discussions on regression models with disordinal interactions.

Table 4: Certification on Saber 11 test scores - by Municipal Development Index '01

[Fixed Effects Estimation]

(a) Mathematics

	Certification only		Municipal Dev. Ind.	
	(1)	(2)	(3)	(4)
	OLS	FE	OLS	FE
Certified	0.064	0.016	-7.074***	-3.666***
	(0.76)	(0.53)	(1.39)	(1.26)
Certified * MDI01			0.158***	0.081**
			(0.03)	(0.03)
.				
Time dummies	Yes	Yes	Yes	Yes
N	389	389	389	389
N groups		30		30
R-sq.	0.39	0.67	0.52	0.68

(b) Spanish Language

	Certification only		Municipal Dev. Ind.	
	(1)	(2)	(3)	(4)
	OLS	FE	OLS	FE
Certified	-0.051	-0.006	-7.701***	-0.915
	(0.80)	(0.26)	(1.52)	(0.55)
Certified * MDI01			0.169***	0.020*
			(0.03)	(0.01)
.				
Time dummies	Yes	Yes	Yes	Yes
N	389	389	389	389
N groups		30		30
R-sq.	0.38	0.77	0.52	0.77

Standard errors clustered by municipality in parentheses

* p<.10 ** p<.05 *** p<.01

Table 5: Falsification test and common-trend assumption

(a) Pre-reform scores (2000 and 2001)										
	Mathematics					Spanish Language				
	(1) B 25%	(2) B 50%	(3) T 50%	(4) T 25%	(5) Int.	(6) B 25%	(7) B 50%	(8) T 50%	(9) T 25%	(10) Int.
Certified	-0.534 (0.53)	-0.166 (0.40)	0.731 (0.43)	0.362 (0.50)	-1.562*** (0.52)	-1.294* (0.76)	0.544 (0.82)	-0.159 (1.21)	1.760 (1.25)	-1.983*** (0.56)
Certif.*MDI'01					0.021*** (0.01)					0.027*** (0.01)
MDI'01 perc.					0.003** (0.00)					0.027*** (0.00)
.										
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,177	1,280	86	50	1,364	1,177	1,280	86	50	1,364
R-sq.	0.002	0.001	0.075	0.056	0.013	0.008	0.010	0.033	0.082	0.233
(b) Pre-reform trend in scores ($\Delta = 2001 - 2000$)										
	Δ Mathematics					Δ Spanish Language				
	(1) B 25%	(2) B 50%	(3) T 50%	(4) T 25%	(5) Int.	(6) B 25%	(7) B 50%	(8) T 50%	(9) T 25%	(10) Int.
Certified	0.996 (0.84)	-0.250 (0.45)	-10.785 (13.99)	0.468 (0.59)	-0.068 (0.43)	1.282 (1.07)	0.484 (0.80)	-18.480 (20.45)	-0.309 (0.60)	0.590 (0.67)
Certif.*MDI'01	-0.027** (0.01)	0.000 (0.01)	0.104 (0.14)		-0.001 (0.00)	-0.025 (0.02)	-0.016** (0.01)	0.193 (0.21)		-0.010 (0.01)
MDI'01 perc.	0.003* (0.00)	0.004** (0.00)	-0.056 (0.12)		0.004** (0.00)	-0.004* (0.00)	-0.004** (0.00)	-0.188 (0.18)		-0.004** (0.00)
.										
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	581	632	42	25	674	581	632	42	25	674
R-sq.	0	0	0	0	0	0	0	0	0	0

Standard errors clustered by municipality in parentheses

* $p < .10$ ** $p < .05$ *** $p < .01$

7 Conclusion

In this paper I exploit the fact that the decentralization reform carried out in Colombia in 2001 employed an arbitrary inhabitant threshold as the sole criterion to assign autonomous management of the public education service to some municipalities. To identify the effect of city-level management of public education, I first employ a sharp regression discontinuity design with population as the running variable and 100 thousand inhabitants the treatment cutoff. Conditional on population, assignment to the treatment is as good as random. I then use an alternative method: local linear fixed effects regression on a ‘discontinuity sample’ of municipalities around the inhabitant cutoff. For municipalities in this group close to the treatment cutoff, the assignment of autonomy over the

education service is as good as random.

I find that the change to local-level management of education had heterogeneous impacts across municipalities. Municipalities that at the time of the reform were characterized by higher levels of development benefitted from freedom in management by improving educational quality as measured by average student test scores. On the other hand, in municipalities with below-average levels of development test scores declined as a consequence of autonomous management. The size of these effects range from a maximum of 0.15 student standard deviations in the positive direction to a maximum of 0.13 student standard deviations in the negative direction, averaging all years after the reform. Looking at the 8th, 9th and 10th year after the reform only, the effect magnitudes are twice as large. This pattern is consistent with the findings of Galiani et al. [2008] for Argentinian schools located in poor versus non-poor cities. I do not find clear effects of local-level management of education on enrollment rates at any school level.

It is worth pointing out that the analysis is carried out on municipalities with populations of large sizes for Colombian standards. Around 90% of Colombian municipalities are smaller than those being looked at in this study. The results I find here may therefore not necessarily be a good prediction of the effect of endowing smaller cities with autonomous management of education - a policy that is in fact currently ongoing in the country.

References

- A. Alesina, A. Carrasquilla, and J.J. Echavarría. Decentralization in colombia. *Fedesarrollo Working Paper Series*, 15, Aug 2000.
- J. Angrist and V. Lavy. Using Maimonides' rule to estimate the effect of class size on scholastic achievement. *The Quarterly Journal of Economics*, 114(2):533–75, 1999.
- P. Bardhan and D. Mookherjee. Decentralizing antipoverty program delivery in developing countries. *Journal of Public Economics*, 89(4):675–704, Apr 2005.
- P. Bardhan and D. Mookherjee. Decentralisation and accountability in infrastructure delivery in developing countries. *The Economic Journal*, 116, Jan 2006.
- H. Blair. Participation and accountability at the periphery: Democratic local governance in six countries. *World Development*, 28(1):21–39, Jan 2000.
- G.J. Borjas and O.L. Acosta. Education reform in Colombia. *Fedesarrollo Working Paper Series*, 19, Aug 2000.
- T. Brambor, W. Roberts Clark, and M. Golder. Understanding interaction models: Improving empirical analyses. *Political Analysis*, 13:1–20, 2005.
- A. Breton. *Competitive Governments*. Cambridge University Press, Cambridge, 1996.
- A. Breton and A. Scott. *The Economic Constitution of Federal States*. University of Toronto Press, Toronto, 1978.
- P. Caballero, editor. *Foro "Descentralización y certificación en educación, experiencias y desafíos, el caso colombiano"*, Bogotá, D.C., Mar 2006. PREAL GDyÁ - Conversemos sobre educación.
- A. Channa and J.P. Faguet. Decentralization of health and education in developing countries: a quality-adjusted review of the empirical literature. *STICERD Economic organisation and public policy discussion papers (EOPP)*, London UK, 38, 2012.
- C. Corte Constitucional. Sentencia su.559/97. Technical report, Corte Constitucional de Colombia, 1997.

- D. Cortés. Do more decentralized local governments do better? An evaluation of the 2001 decentralization reform in Colombia. *Serie documentos de trabajo - Universidad del Rosario*, 84, Jun 2010.
- R. Crook and J. Manor. *Democracy and Decentralisation in South Asia and West Africa: Participation, Accountability and Performance*. Cambridge University Press, Cambridge, 1998.
- DNP DDTS. Evaluación del sistema general de participaciones 2003. Technical report, Departamento Nacional de Planeación - Dirección de Desarrollo Territorial, Bogotá, D.C., Dec 2004.
- DNP. Documento conpes social n.57. Technical report, Departamento Nacional de Planeación, Bogotá, D.C., Jan 2002.
- DNP. Documento conpes social n.159. Technical report, Departamento Nacional de Planeación, Jan 2013a.
- DNP. Documento conpes social n.162. Technical report, Departamento Nacional de Planeación, Bogotá, D.C., Mar 2013b.
- J.P. Faguet and F. Sanchez. Decentralization's effects on educational outcomes in Bolivia and Colombia. *World Development*, 36(7):1294–1316, 2008.
- J.P. Faguet and F. Sanchez. Decentralization and access to social services in Colombia. *Public Choice*, 160(1-2): 227–249, Jul 2014.
- S. Galiani, P. Gertler, and E. Schargrodsky. School decentralization: Helping the good get better, but leaving the poor behind. *Journal of Public Economics*, 92:2106–20, 2008.
- A.S. Gómez, L.P. Tovar, and C. Alam. *Situación de la educación básica, media y superior en Colombia*. Casa Editorial El Tiempo - Fundación Corona - Fundación Antonio Restrepo Barco, 2001.
- G.W. Hammond and M.S. Tosun. The impact of local decentralization on economic growth: Evidence from U.S. counties. *Journal of Regional Science*, 51(1):47–64, 2011.
- G. Imbens and G. Lemieux. Regression Discontinuity Designs: A guide to practice. *Journal of Econometrics*, 142(2): 615–635, Feb 2008.
- A.M. Iregui B., L. Melo B., and J. Ramos. Evaluación y análisis de eficiencia de la educación en Colombia. Technical report, Banco de la República, Colombia, Bogotá, D.C., Feb 2006.
- J. Juetting, E. Corsi, C. Kauffmann, I. McDonnell, H. Osterreider, N. Pinaud, and L. Wegner. What makes decentralization in developing countries pro-poor? *The European Journal of Development Research*, 17(4):626–48, 2005.
- K. Kaiser. Decentralization reforms. In *Analyzing the Distributional Impact of Reforms*. World Bank, Washington, 2006.
- M. Kurata and Y. Ikemoto. *Fiscal Decentralization and Development. Experiences of Three Developing countries in Southeast Asia*. Palgrave Macmillan, Jul 2012.
- I. Lonzano, J. Ramos, and H. Rincón. Implicaciones fiscales y sectoriales de la reforma a las transferencias territoriales en Colombia. *Borradores de Economía - Banco de la República, Colombia*, 437, Apr 2007.
- J. Manor. *The Political Economy of Democratic Decentralization*. World Bank, Washington, Mar 1999.
- R. Musgrave. *The Theory of Public Finance*. McGraw-Hill, New York, 1959.
- W. Oates. *Fiscal Federalism*. Harcourt Brace Jovanovich, New York, 1972.
- U. Panizza. What drives fiscal decentralisation? *CESifo DICE Report 1/2004*, 2004.
- M. Santa María S., N. Millán U., J. Moreno B., and C.F. Reyes. La descentralización y el financiamiento de la salud y la educación en los departamentos: ¿Cuáles son las alternativas? Informe final, Federación nacional de departamentos y Fedesarrollo, Dec 2009.
- A. Sarmiento and J.E. Vargas. Descentralización de los servicios de educación y salud en Colombia. *Conyuntura Social - Fedesarrollo / Instituto SER de Investigación*, 16:91–136, May 1997.
- N. Singh. Decentralization and public delivery of health care services in India. *MPRA Paper No. 7869*, Mar 2008.
- J. Stevens. Interaction effects in ANOVA. University of Oregon, <http://pages.uoregon.edu/stevensj/interaction.pdf>, 1999.

- C. Tiebout. A pure theory of local expenditures. *Journal of Political Economy*, 64:416–24, 1956.
- G. Toro. Trabajamos por la descentralizacion, la gobernabilidad y la autonomia local. Presentacion, Federación Colombiana de Municipios (FCM), Jun 2006.
- C.H. Vergara and M. Simpson. Evaluación de la descentralización municipal en colombia. Estudio general sobre los antecedentes, diseño, avances y resultados generales del proceso de descentralización territorial en el Sector educativo. *Archivos de Economía - Departamento Nacional de Planeación*, 168, Dec 2001.

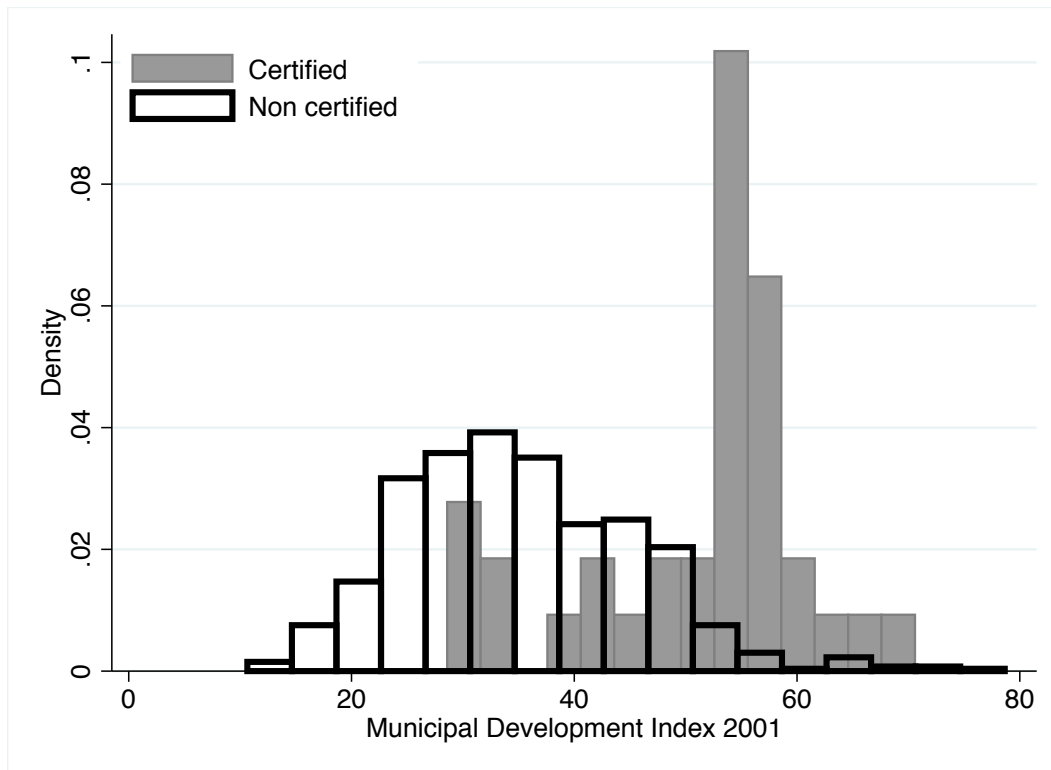
Appendix [*Some of these sections are current work in progress*]

8 Population and Municipal Development Index distributions

Figure 4 shows the distributions of the municipal development measures by certification status. Figure 5 is an extension of Figure 1, illustrating population and MDI distributions for a wider range of municipalities.

Figure 4: Distribution of MDI by certification

(a) Densities



(b) Frequencies

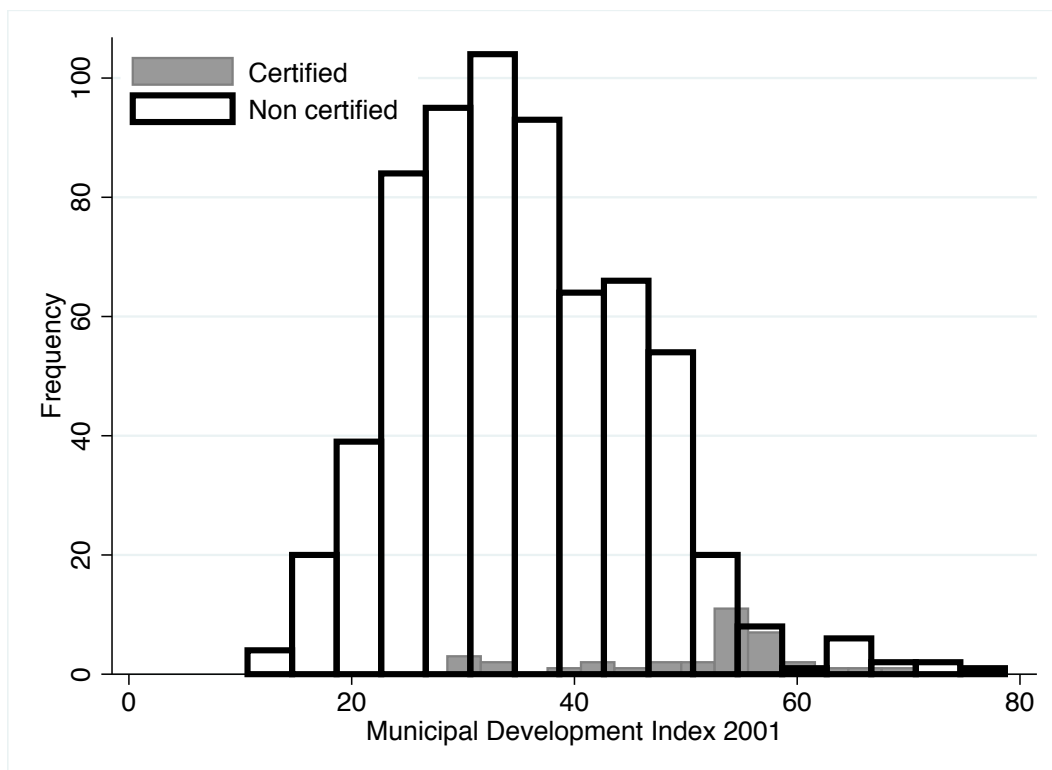
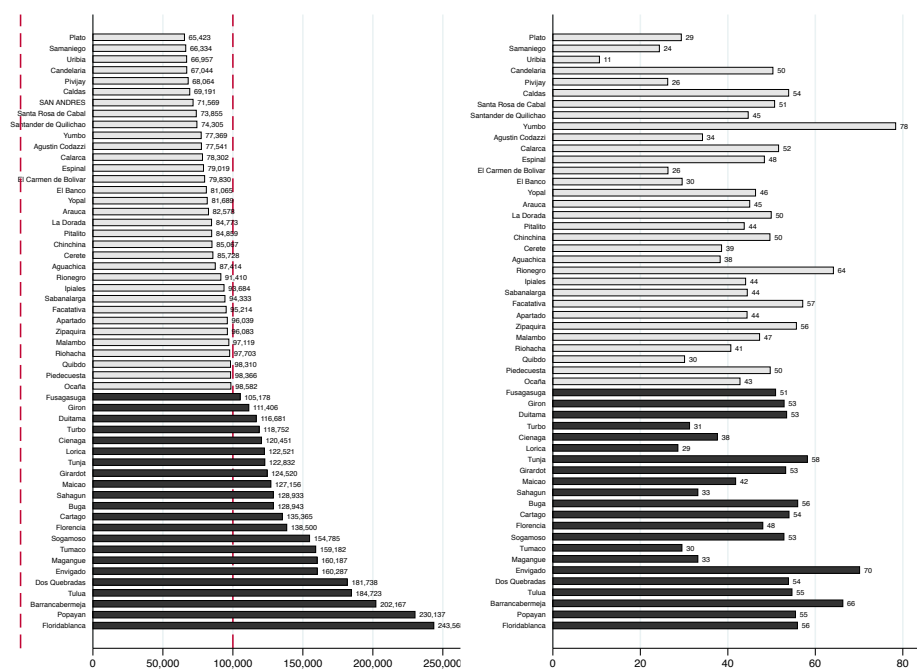
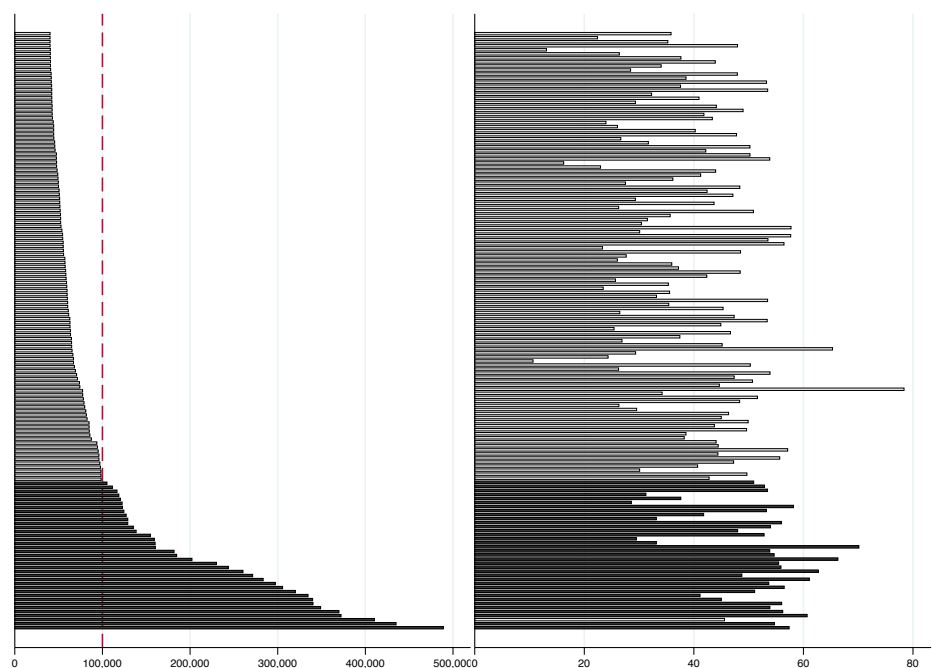


Figure 5: Population and MDI distributions

(a) 65 to 250 thousand inhabitants

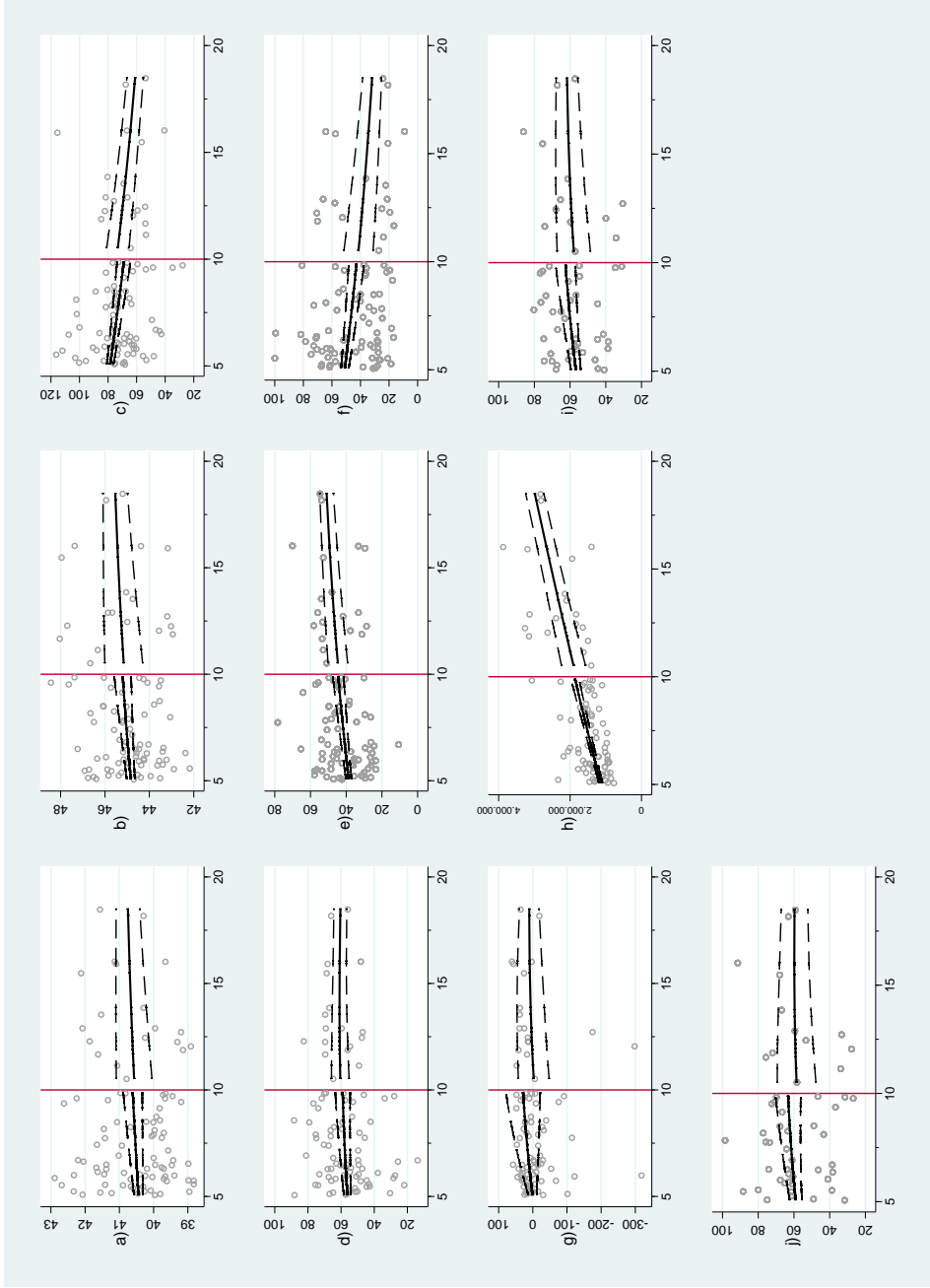


(b) 40 to 500 thousand inhabitants



9 Smoothness checks

Figure 6: Smoothness of municipal characteristics across the discontinuity



- a) Municipal Maths score average 2001 (value); b) Municipal Spanish Language score average 2001 (value); c) Gross primary school coverage 2001 (percent); d) Gross secondary school coverage 2001 (percent); e) Municipal Development Index 2001 (value); f) Unsatisfied Basic Needs indicator 1993 (value); g) Share of saved municipal current revenues (percent); h) Central Govt. transfers for education 2001 (1,000s of Pesos); i) Transparency index 2005 (value); j) Visibility and accountability index 2005 (value).

10 Robustness checks [*Current work in progress*]

10.1 Regression Discontinuity Estimation

10.1.1 Different polynomials at each side of the cutoff

Table 6 replicates the results shown in Table 2 allowing for a different polynomial on each side of the certification cutoff. In econometric terms, this table shows the results of fitting the models $Y_i = \alpha + \tau^{RD} C_i + \beta D_i + f(P_i) + f(P_i) \times C_i + \epsilon_i$ and $Y_i = \alpha + \tau_0^{RD} C_i + \tau_1^{RD} C_i * D_i + \beta D_i + f(P_i) + f(P_i) \times C_i + \epsilon_i$, where $f(P_i)$ is a third-order polynomial of population P_i . The results from the main section are robust to these alternative model specifications.

Table 6: Certification on Saber 11 test scores - by Municipal Development Index '01 (2 polynomials)

(a) Mathematics						
	(1) All	(2) Bottom 25%	(3) Bottom 50%	(4) Top 50%	(5) Top 25%	(6) Interaction
Certified	0.176 (1.12)	-2.259* (1.37)	1.211 (1.60)	-0.307 (1.27)	3.065*** (0.81)	-2.267** (0.88)
Certif.*MDI'01 perc.						0.038*** (0.01)
MDI'01 percentile						0.023*** (0.00)
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes
N	7,572	6,536	7,100	472	275	7,561
R-sq.	0.013	0.003	0.004	0.028	0.073	0.084

(b) Spanish Language						
	(1) All	(2) Bottom 25%	(3) Bottom 50%	(4) Top 50%	(5) Top 25%	(6) Interaction
Certified	0.072 (1.14)	-3.602*** (1.31)	1.274 (1.60)	-0.432 (1.18)	2.379** (1.10)	-2.043** (0.96)
Certif.*MDI'01 perc.						0.035*** (0.01)
MDI'01 percentile						0.031*** (0.00)
F(Population)	Yes	Yes	Yes	Yes	Yes	Yes
N	7,572	6,536	7,100	472	275	7,561
R-sq.	0.018	0.003	0.004	0.029	0.073	0.124

10.2 Fixed Effects Estimation

10.2.1 Different cutoffs for the discontinuity sample

Table 7 shows the results of Table 4 employing different choices of the discontinuity-sample.

Table 7: Different sample cutoffs

		90,000 - 120,000				90,000 - 120,000		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mate	Mate	Lang	Lang	Mate	Mate	Lang	Lang
Certified	0.906 (0.93)	-6.303*** (0.78)	0.873 (1.36)	-10.119*** (0.99)	0.352 (0.44)	-2.972** (1.19)	0.283 (0.63)	-7.192*** (1.45)
Certified * MDI01		0.153*** (0.02)		0.233*** (0.02)		0.072** (0.03)		0.162*** (0.03)
.								
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	194	194	194	194	595	582	595	582
N groups	15	15			46	45		
R-sq.	0.68	0.69	0.35	0.49	0.61	0.62	0.40	0.49

Standard errors clustered by municipality in parentheses

* p<.10 ** p<.05 *** p<.01

10.2.2 Explicitly controlling for population

Table 8 shows the local linear regression results of Table 4 with the addition of the population control variable. As expected, since we are operating on a discontinuity sample, results remain almost identical.

Table 8: Population control

10.2.3 Development-specific time trends

Here I show results obtained by allowing for development-specific time trends. I introduce a linear time trend and interact it with the development measures, as well as with certification status. This way I allow different levels of pre-reform municipal development to drive different over time trends in test scores. The development-specific time trends do take away some of the magnitude and significance from results, but the qualitative patterns remain unchanged - except for the language score and the MDI 01 interaction, which seems most affected by the new specification choice.

Table 9: Development-specific time trends

10.2.4 Effect on later years; Excluding years 2011 and 2012

In this table I show the results of Table 4 excluding test scores of years 2011 and 2012