1 Introduction

Access to free health insurance could have a positive effect on education, which in turn is a relevant determinant of growth and economic development. In this paper we exploit the case of a large expansion of a publicly provided health insurance program in Mexico to empirically analyze its impact on children's education outcomes. We find a positive effect of the program on enrollment rates to primary and secondary school and on academic performance in standardized tests.

In 2002, the Mexican government introduced Seguro Popular (SP), a health insurance program for households not covered by social security institutions, estimated to be around half of the country's population. SP provides health services and medicines practically free of charge. To test whether its expansion had an effect on education outcomes, we use a panel of municipalities from 2007 to 2010. We focus on SP's effect on enrollment rates of children attending primary and secondary school, and on standardized test scores for primary school children. Our measure of the expansion of coverage is the proportion of the population in the municipality covered by SP. To address possible endogeneity concerns associated to omitted variables we use a fixed effects model. Furthermore, given the nature of the variables we focus on, we believe that we do not face the reverse causality problem that studies in the health and education literature could have to sort out. In fact, it is difficult to think of some mechanism through which children's enrollment to school or their test scores may affect SP coverage. To control for possible changes over time within municipalities that could affect both health coverage and academic results, we include as independent variable in our estimations the per capita amount of public transfers for the poverty reduction program Oportunidades, which has both a health and an education component. Although we do not have pre-program data, we perform a placebo test to provide evidence against pre-existing trends using municipalities that enrolled to SP later on our study period. Our findings suggest that SP coverage has a positive and statistically significant effect on school enrollment of children to late primary and early secondary school. Although the effect on younger children's enrollment (early primary) is also positive, it is not statistically significant in the main specification. Our estimations also point at an important and statistically significant effect of SP coverage on children's scores in standardized tests.

It is possible to consider different mechanisms through which publicly provided health insurance could improve education. The most direct channel is through better health. Indeed, healthier parents and children could lead to higher school enrollment and attendance and to an increase in effective study time (see Miguel (2005) for a review on evidence from various countries). Some important studies in this area include Glewwe et al. (2001) who, using a longitudinal data set for the Philippines, found that better nutrition caused children to enroll in school earlier and improved their performance. Alderman et al. (2001), for the case of Pakistan, argue that better health and nutrition have a positive impact on school enrollment. Using an experimental approach based on randomized treatments for worm infections in Kenya, Miguel and Kremer (2004) find that better health increased school attendance, although not academic performance. Similarly, Todd and Winters (2011), using the randomization structure of the conditional cash transfers program in Mexico, Oportunidades, argue that interventions on early health and nutrition have a positive effect on school enrollment. Moreover, using a fixed effects strategy, Lavy et al. (2012) show that exposure to air pollution is associated with declines in standardized test scores in Israeli high schools.

Another mechanism through which access to free-of-charge publicly provided health insurance could improve educational outcomes is by increasing the amount of resources available for education expenses. Indeed, health insurance could reduce both out-of-pocket and catastrophic health expenditures by the household. This implies that families could reallocate resources previously devoted to solve health problems into education. Budget constraints actually interfere with households' education choices, particularly in higher grades. For example, according to a survey conducted by the Mexican Ministry of Education, 50 percent of Mexicans report lack of money to pay for material, transport or tuition as one of the main causes for not starting high school or dropping out from it (SEP, 2012). It is possible that an increase in disposable income may facilitate access to food, transportation, books, pencils, and notebooks, which could in turn increase the return to time spent in school. For the case of China, Brown and Park (2002) found that wealth increases children's test scores significantly, and that dropout probabilities of children in families that are credit constrained and poor are three times higher. Additionally, some studies have shown that low levels of investment in education could be the consequence of low income levels (Moran et al., 2003). In a literature review on this topic, Lochner and Monge-Naranjo (2011) argue that exogenous increases in family income lead to improvements in early child development. Besides, health insurance could help households to cope better with health shocks without interfering with their decisions regarding education.

On the other hand, Hanson and Woodruff (2003) argue that the main cost of education in poor countries are generally the foregone earnings of the child rather than the direct costs. Therefore, it is costly to keep children in school full time when they could instead be involved in productive activities. Access to free health insurance may alleviate budget constraints and therefore avoid the need to take children out of school and send them to work in order to reduce expenses and increase income. In this respect, Edmonds and Schady (2012) found that a direct monetary transfers program in Ecuador caused a decrease in child labor. The authors interpret their results as evidence

2 Expansion of the public health insurance system

Barros (2008) and King et al. (2009) found that SP has a positive effect on self-perceived health. However, some studies have not been able to identify a statistically significant effect of SP on objective health measures (Barros, 2008; Knox, 2008). Evidence seems more compelling with respect to the income channel. Several studies have found that SP actually reduces out-of-pocket health expenditure (Galarraga et al., 2010; Barros, 2008), and different papers have found that SP reduces catastrophic health expenditures (Galarraga et al., 2010; Gakidou et al., 2006; Knaul et al., 2006; Barros, 2008; King et al., 2009). Although it seems reasonable that SP reduces uncertainty given the insurance component, we are not aware of papers formally documenting that this is the case.[3]

Given the large segment of the population that SP intends to cover, the program was implemented gradually across the country and full coverage is expected to be achieved by 2013 (Levy, 2008). With this objective, promotion and affiliation brigades are organized regularly,[4] meaning that enrollment rates at the municipality level are also progressive. As of 2012 SP had enrolled 52.7 million beneficiaries (Sistema de Proteccion Social en Salud, 2012). Some authors like Barros (2008) and Bosch and Campos-Vazquez (2010) have argued that political factors could have influenced the rollout schedule of the program. This has played in favor of different identification strategies in various studies. In our paper, although the use of a longitudinal dataset and of a fixed effects specification can account for possible endogeneity issues, the exogenous variation in SP could be an additional factor supporting the results.

3 Empirical model, data and descriptive statistics

In order to identify the effect of SP on education outcomes we estimate a fixed-effects model with school enrollment rates and ENLACE test scores at the municipality level as dependent variables, and SP coverage, along with an additional control, as independent variables. The regressions take the following form:

$$education\ outcome_{it} = \ ^{sp} SP_{it} + \ Op_{it} + \ _{i} + \ _{st} state_{s} \ year_{t} + u_{it} \tag{1}$$

[3] An important branch of the SP literature has focused on whether this program could induce informality (workers with access to social security institutions moving to jobs without such access), as suggested by Levy (2008). No strong evidence has been found in this direction (Barros, 2008; Campos-Vazquez and Knox, 2010; Azuara and Heckman, 2010).

[4] Seguro Popular operation rules detail that states' health institutions are responsible for the diffusion, and with this goal they should organize promotion and affiliation campaigns.

where SP_{it} is the SP coverage variable in municipality i at time t; $\;_i$ are municipality fixed effects; $state_s$ and $year_t$ are state and year dummies respectively, so that by considering the interaction in the regression, we include state-specific time fixed effects to control for possible changes over time that could affect all municipalities in the same state in a similar fashion;[5] Op_{it} is per capita public expenditure in Oportunidades transfers in state i at time t; and u_{it} is the error term.

Municipality fixed effects allow us to control for observable and unobservable characteristics at the municipality level that do not change over time and that could simultaneously affect education and SP enrollment levels. This addresses possible endogeneity problems related to constant-in-time unobservables. However, the concern regarding possible factors that could be changing over time differentially across municipalities that could affect both SP expansion and test scores remains. To address this possibility to some extent, we include Oportunidades transfers, that vary in time and could have a simultaneous effect on health provision and on student's performance differently across municipalities. As is well known (see Levy and Rodríguez, 2005), Oportunidades is a poverty

In order to estimate equation (1), we construct a panel of municipalities with annual data from 2007 to 2010 with information on school enrollment rates measured by the proportion of children of school age who are enrolled, academic performance measured by the results in standardized tests, and SP coverage measured by the proportion of the population registered in SP. Our main sources of information were the Ministry of Education, the Ministry of Health, and Mexico's National Statistics Institute INEGI (Instituto Nacional de Estadística y Geografía). We restricted the analysis to this time period due to data availability. However, as will be seen below, there is considerable variation in SP coverage in the period, as the program was in an expansion phase throughout the country.

Our first outcome of interest is children's enrollment rate at the municipality level. In the Mexican education system, children start school at the age of 3. The official system consists of three years of preschool, six years of primary school, and three years of secondary school. Official estimates of the primary school gross coverage rate in Mexico are computed as the proportion of children aged 6 to 12 who are attending school, while secondary school gross coverage rate is computed as the proportion of children aged 13 to 15 who are attending school. This means that, although primary school in Mexico consists of only six grades, the Ministry of Education considers an age range of seven years as the official period to attend primary school. The information is published at the national and state level (INEE, 2011), but not at the municipality level, which is what is required for our purposes. Therefore, using different data sources we computed enrollment rates at such geographical level. Unfortunately, annual data on the population by age is not available at this disaggregation level. At the municipality level, data on population is only available for five-year age groups. Consequently, we could not construct the corresponding primary school and secondary school coverage rates, and we instead had to divide the analysis in two groups which correspond to the five-year age groups available in the population data source. The first group corresponds to children aged 5 to 9, and the second corresponds to those aged 10 to 14. To construct enrollment rates with the available data and following the Ministry of Education's methodology as closely as possible, we take the number of children attending grade 3 in preschool to grade 3 in primary school at the municipality, and we divide it by the number of children aged 5 to 9 living in that municipality. Correspondingly, we take the number of children attending grades 5 in primary school to grade 2 in secondary school, and divide it by the number of children aged 10 to 14 in the municipality. Onwards, we will refer to the former indicator as the enrollment rate to early primary school, whilst we will refer to the enrollment rate of children attending grades 5 in primary school to 2 in secondary school as the enrollment rate to late primary and secondary school. Data on the number of children enrolled in each grade was obtained from the Ministry of Education webpage. In turn, this information comes from a questionnaire at the school level that is carried out at the beginning

in the exam, such as possible changes in the difficulty of the questions or the implementation process.

Our indicator of yearly SP coverage by municipality was constructed as the number of persons enrolled in SP relative to the total population in the municipality. For the purposes of identifying the effect we are after, we need to consider SP coverage, which is our independent variable, as the accumulated coverage by the month when the dependent variable of interest is measured. Consequently, given that school starts in August, the SP coverage variable used for the estimations of its effect on school enrollment rate corresponds to the coverage achieved up to that month of each year. In turn, we take SP coverage by April of each year for the estimation of its effect on standardized tests scores, since this exam takes place at that month. Data on the number of persons registered in SP at the end of each month comes from the SP National Registry and was provided to us by the Ministry of Health. Again, estimations on yearly population size at the municipality level were obtained from the Ministry of Health webpage.[9] A possible concern with this measure of SP coverage is that it may be correlated with some characteristics of the municipality, such as the percentage of the population with access to social security institutions, which could in turn be linked to the municipality's wealth, health status, or to the quality of its education system.

Our sample consists of 2,419 municipalities (98% of the total) over the span of four years.[11] Figures 1 and 2 show kernel density estimates for the average school enrollment rate to early primary school and to late primary and secondary school respectively. Figure 1 shows that the distribution of enrollment rates to early primary shifted to the right between 2007 and 2010. Indeed, Table 1 shows that the mean enrollment rate to early primary school was 94 per cent, 97 per cent, 100 per cent, and 103 per cent in 2007, 2008, 2009 and 2010 respectively. As explained above, several reasons could explain gures above 1 for the enrollment rates. Figure 2 suggests that the distribution of the enrollment rate to late primary and secondary school has not changed very much over time. As Table 1 reports, the mean enrollment rate recorded values around 80 per cent throughout the study period. The gure shows that there is important variation between municipalities throughout the period. Figure 3 shows kernel density estimates for the average scores in the ENLACE standardized test. Note that there is variation both across municipalities and across time. As Table 1 reports, the mean scores for 2007, 2008, 2009, and 2010 are 475, 481, 484, and 495 respectively. Additionally, there is important variation both between and within municipalities.

Figure 4 presents kernel density estimates of the SP coverage variable by each year's April. There is important variation between municipalities in each of the four years that constitute our database. As can be noted, in the early years of our sample a relevant proportion of municipalities had very low SP coverage (note the spike in 2007). Indeed, the distribution has shifted to the right over time, suggesting that coverage has increased across municipalities, which is important for our identi cation strategy. As Table 1 shows, average coverage was 26% in 2007, 34% in 2008, 42% in 2009, and 52% in 2010. Additionally, the table indicates that although most of the variation in 7(strsie6datab2a4-479(thenally)841gh)-34Ago385(althcy)841ghalthough enrollment rate to late primary and secondary school. The coefficients on SP coverage indicate a positive and statistically significant effect. Attending secondary school is generally more expensive, not only in terms of direct educational expenses, but also because of the higher opportunity cost of older children in terms of their foregone earnings. It could therefore be the case that the decrease in budget constraints is allowing households to pay for the additional expenditures that the assistance of children to secondary school entails. More importantly, SP may be allowing households to send children to school instead of sending them to work. The comparison of these results with those for younger children suggests that this channel may indeed be more important for older children. Therefore, the evidence is consistent with the hypothesis that one of the channels through which SP coverage affects education is through an indirect income effect. However, an additional explanation that may account for the lack of significance in the results for younger children is the little variation in accumulated schooling before the age of 10, given that primary school attendance has been mandatory for many years in Mexico (Hanson and Woodruff, 2003). This implies that there is a lower margin for increasing enrollment rates to early primary.

Our results imply that going from no coverage to having all the population registered to SP would translate in an increase of 2.5 percentage points in the enrollment rate to late primary and secondary school (Column 4 of Table 2). However, SP is targeted to the population not covered by social security, and therefore not every person in the municipality is expected to be enrolled. A more reasonable range would be to go from no coverage to 52 percent of the population enrolled, for example, which was the mean SP coverage across municipalities in 2010. Considering an increase of this magnitude, our coefficient implies an increase of 1.3 percentage points in enrollment to late primary and secondary school. This is an increase of considerable magnitude, as it represents 1.6% of the mean enrollment rate to these grades in the relevant period.

With respect to the estimations on test scores of primary school children, Columns 5 and 6 in Table 2 present the results. Column 5 includes only municipality fixed effects, together with state-specific time fixed effects, and no control. The coefficient indicates a positive and statistically significant effect of SP coverage on test scores. The coefficient maintains a similar value and significance level when we include Oportunidades transfers as control.

The interpretation of the effect of SP coverage on test scores is not as straightforward. Table 3 puts our findings in perspective by giving some benchmarks to understand whether the increase in the mean score associated to higher SP coverage is economically relevant. The coefficient in Column 6 of Table 2, our main specification, takes a value of 11.38, which means that if a municipality goes from having no persons registered in SP to having everyone enrolled, the test score average would increase by 11.38 points. However, for the reasons explained above, the exercises presented in Table 3 again take as reference an increase in SP coverage of 52 percentage points. Therefore, Table 3 assumes an increase in SP coverage from 0 to 52 percent, which would imply an increase of 5.9 points in the average score, according to the reported coefficient. The first row proposes as point of reference the gap in average test scores between the state with the best performance and the one with the worst, where the average test score in a state corresponds to the average across municipalities. In 2007, the difference between Mexico City, the region with the highest average score, and Chiapas, the state with the lowest average score was 117.7 points, which implies that the simulated expansion in SP of 52 percentage points corresponds to 5 percent of the gap. The second row considers the gap between the score of the state in the 90th percentile of test scores across states and that in the 10th percentile, which is equal to 43.39 points. An increase in SP coverage of 52 percentage points would be associated to an increase in test scores equal to 13.6 percent of this gap. The last row proposes as point of reference the standard deviation of average scores across municipalities in 2007 (38 points). The estimated effect of an equally large SP expansion corresponds to 15.6 percent of such standard deviation. According to the World Economic Forum (2009), a policy that increases test scores in 10 percent of the standard deviation may be considered successful. We therefore believe that the effects we find are sizable, although in interpreting the results, one should remember that it may have taken a municipality around eight years to go from no coverage to 52 percent. On the other hand, it is also important to also bear in mind that we are estimating the effects of a program that did not target academic performance directly.

As was mentioned above, a fixed effects specification controls for time-invariant differences between municipalities that received SP earlier with respect to those that enrolled to the program later on. Moreover, it has been argued that the SP rollout schedule was not related to development indicators, but that it could have been the result of political factors (Barros, 2008; Bosch and Campos-Vazquez, 2010). In spite of these arguments, a threat to our identification strategy could be related to possible differences in trends in education outcomes before the program started between those municipalities that received SP earlier and those where we observe SP enrollment at a later stage. Ideally, we would like to verify that education outcomes were evolving similarly in municipalities that adopted SP early and in those that adopted SP later in time. Unfortunately, we do not have information on the education outcomes that we focus on for the years before SP was implemented. Nevertheless, we can provide suggestive evidence of the absence of pre-existing then compare education outcomes of early adopters, among those in the restricted sample, with the outcomes of municipalities that enrolled to SP even later on. Using the restricted sample, we show that the trends in schooling outcomes are not correlated with the timing of enrollment to SP.

Going into the details of the test, data on the education outcomes we use is available for the period 2007 to 2010. We observe that almost none of the municipalities in our sample had zero SP coverage in our timeframe. However, we can still perform the test as we do nd a large enough

As additional robustness checks we conducted exercises to consider other forms of time fixed effects. In particular, we substituted the state-specific time fixed effects with simple time fixed effects, state-specific trends, and a combination of both. Results are presented in Tables 5, 6 and 7. Table 5 provides weak evidence suggesting that there is certain positive effect of SP enrollment in enrollment rates to early primary school. However, once we control for time fixed effects and we allow differentiated effects among states (either by having state-specific trends or state-specific time fixed effects), this effect is no longer statistically significant. Table 6 supports the evidence of Table 2 pointing at a positive and statistically significant impact of SP coverage on school enrollment to late primary and secondary school. Only when we include simple time fixed effects the coefficient becomes much smaller and not statistically significant. Finally, Table 7 presents the robustness check for the estimation of health insurance coverage on standardized test scores and all specifications point to an important effect.[13]

5 Conclusion

The evidence presented in this paper suggests that the introduction of Seguro Popular, a program intended to provide public health insurance essentially free of charge in Mexico to the population not covered by social security, had a positive and statistically significant effect on education outcomes, namely on enrollment rates to late primary and secondary school and on academic performance of children in primary school. We use a panel of municipalities to show that the expansion of SP coverage increased school enrollment and average test scores. This effect could be attributed to improved health or to an income effect, due to, for example, lower expenditures in health. Given the reduced form of our estimates, we are not able to identify the channels through which higher SP coverage could be improving children's academic performance. The identification of these channels is left for future work.

However, given the strong evidence showing that the introduction of SP has led to savings in health expenditures that has been documented in previous papers (Barros, 2008; Gakidou et al., 2006; Galarraga et al., 2010; King et al., 2009; Knaul et al., 2006), it is likely that households are allocating part of those resources to education expenditures or to send their children to school instead of work, thus helping their children to achieve higher test scores or increasing school enrollment rates. We provided evidence of a statistically significant impact of the expansion of SP on late primary and secondary school enrollment, but the effect on early primary school and preschool

[13] Additional robustness checks consisted on weighting the observations by the 2007 population for all regressions. The estimations point at positive effects and that are always statistically significant.

enrollment is not statistically significant in the main specification. Because attending secondary school is generally more time consuming and expensive, both in terms of opportunity cost (as children aged 10 to 14 are more productive in the house or could earn higher wages than those aged 5 to 9) and in education-related expenditures (as books are more expensive and households may have to incur in additional transportation expenses), a significant effect on enrollment to late primary and secondary school could be indicating that households are being able to cope better with additional expenditures. We interpret the result of a differential effect on older versus younger children as an indication that households could have been budget constrained and that relaxing these constraints possibly allowed them to send their children to school and to increase education expenses. Nonetheless, the importance of the channels associated to improved health and diminished uncertainty regarding future income resulting from increased health insurance coverage cannot be ruled out. We find remarkable that SP has improved academic performance of Mexican children when its main goal is to provide better health services.

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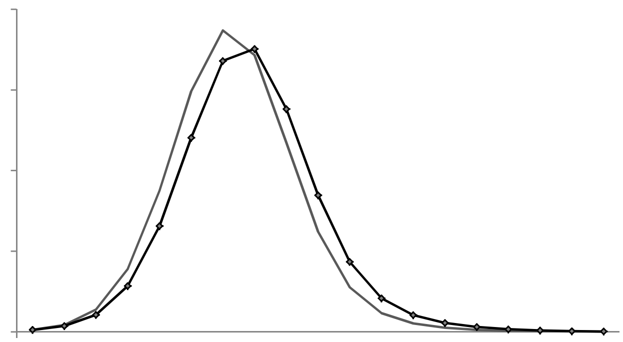
7 Figures and Tables

Figure 1

Distribution of enrollment rates to early primary school across municipalities

Gaussian Kernel Density

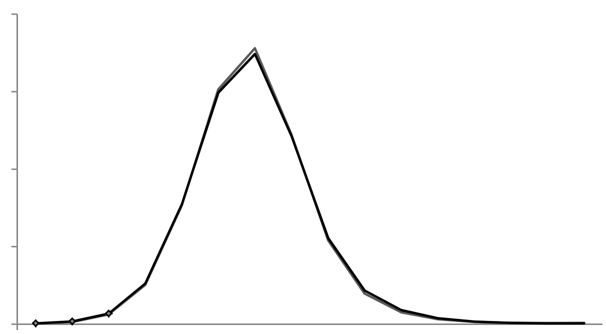


Note: Units of observations are municipalities. Own calculations based on information from the Ministry of Education and the Ministry of Health. Enrollment rate to early primary school corresponds to the number of students registered to grades 3 in preschool to 3 in primary school at the municipality level divided by the population in the municipality aged 5 to 9 years.

Figure 2

Distribution of enrollment rates to late primary and secondary school across municipalities

Gaussian Kernel Density

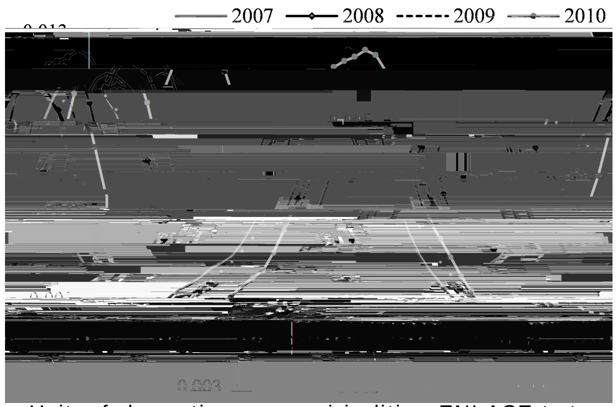


Note: Units of observations are municipalities. Own calculations based on information from the Ministry of Education and the Ministry of Health. Enrollment rate to late primary and secondary school corresponds to the number of students registered to grades 5 in primary school to 2 in secondary school at the municipality level divided by the population in the municipality aged 10 to 14 years.

Figure 3

Distribution of average ENLACE test scores across municipalities

Gaussian Kernel Density

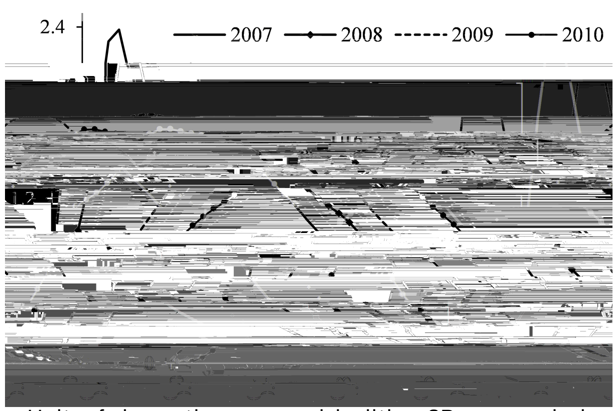


Note: Units of observations are municipalities. ENLACE test scores correspond to the average score of the schools at the municipality. Own calculations based on information from the Ministry of Education.

Figure 4

Distribution of SP coverage across municipalities

Gaussian Kernel Density



Note: Units of observations are municipalities. SP coverage is de ned as the proportion of the population in the municipality enrolled in SP by each year's April. Own calculations based on information from the Ministry of Health.

Table 2

Fixed e ects estimation results of the e ect of SP on education outcomes

(1)

*** p<0.01, ** p<0.05, * p<0.1 Clustered standard errors in parenthesis.

Note: Seguro Popular (SP) coverage is de ned as the proportion of the population in the municipality enrolled in SP. ENLACE test scores correspond to the average score of the schools at the municipality. Enrollment rate to early primary school corresponds to the number of students registered to grades 3 in preschool to 3 in primary school at the municipality level divided by the population in the municipality aged 5 to 9 years. Enrollment rate to late primary and secondary school corresponds to the number of students registered to grades 5 in primary school to 2 in secondary school at the municipality level divided by the population in the municipality aged 10 to 14 years.

Table 4

Relationship between the date of introduction of SP and pre-program education outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Received SP in 2009	-0.014	-0.015	-0.002	0.000	0.554	-0.594
	(0.010)	(0.011)	(0.010)	(0.010)	(3.458)	(3.796)
Oportunidades		0.006		-0.013**		4.776
		(0.007)		(0.006)		(2.982)
Constant	0.047***	0.041***	0.005	0.018***	8.441***	4.627**

*** $p<0.01$, ** $p<0.05$, * $p<0.1$. Robust standard errors in parenthesis.

Note: The sample is restricted to municipalities that by 2008 had SP coverage below 10 percent. Observations that in 2009 had between 10 and 20 percent coverage are dropped. Received SP in 2009 is a dummy variable indicating whether SP coverage at the municipality was above 20 by 2009. ENLACE test scores correspond to the average score of the schools at the municipality. Enrollment rate to early primary school corresponds to the number of students registered from grades 3 in preschool to 3 in primary school at the municipality level divided by the population in the municipality aged 5 to 9 years. Enrollment rate to late primary and secondary school corresponds to the number of students registered from grades 5 in primary school to 2 in secondary school at the municipality level divided by the population in the municipality aged 10 to 14 years.

Table 7

Additional fixed effects estimations

Dependent variable: ENLACE test scores

	(1)	(2)	(3)	(4)
SP coverage	6.32*	10.37***	9.86***	11.38***
	(3.42)	(3.76)	(3.76)	(3.94)
Oportunidades	-0.41	0.18	0.15	0.16
	(0.31)	(0.34)	(0.34)	(0.43)
Constant	473.1***	-9,390***	-9,921***	470.8***
	(0.98)	(835.5)	(825.9)	(1.16)
R-squared	0.147	0.216	0.219	0.248
Observations	8,310	8,310	8,310	8,310
Number of municipalities	2,418	2,418	2,418	2,418
Municipality fixed efects				
Time fixed effects		×		×
State-specific time trend	×			×
State-specific time fixed effects	×	×	×	

*** p<0.01, ** p<0.05, * p<0.1 Clustered standard errors in parenthesis.
Note: Seguro Popular (SP) coverage is defined as the proportion of the population in the municipality enrolled in SP. ENLACE test scores correspond to the average score of the schools at the municipality.