I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16791

Improvements in Schooling Opportunities and Teen Births

Lucas N. Garcez
María Padilla-Romo
Cecilia Peluffo
Mayra Pineda-Torres

FEBRUARY 2024

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16791

Improvements in Schooling Opportunities and Teen Births

Lucas N. Garcez
University of Tennessee

Cecilia Peluffo
University of Florida

María Padilla-Romo
University of Tennessee and IZA

Mayra Pineda-Torres
Georgia Institute of Technology

FEBRUARY 2024

Any opinions expressed in this paper are those of the author(s) and not those of IZA. Research published in this series may include views on policy, but IZA takes no institutional policy positions. The IZA research network is committed to the IZA Guiding Principles of Research Integrity.

The IZA Institute of Labor Economics is an independent economic research institute that conducts research in labor economics and offers evidence-based policy advice on labor market issues. Supported by the Deutsche Post Foundation, IZA runs the world's largest network of economists, whose research aims to provide answers to the global labor market challenges of our time. Our key objective is to build bridges between academic research, policymakers and society.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be available directly from the author.

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Improvements in Schooling Opportunities and Teen Births*

We study the causal relationship between educational attainment and teenage birth rates by focusing on a large-scale, country-wide reform that made high school compulsory and removed previously existing school capacity constraints in Mexico. Relying on administrative data on schools and births, we implement a difference-in-differences strategy that exploits variation across time and municipality-level exposure to the reform to explore the effects of expanding educational opportunities on teenage fertility. We find that teenage birth rates decreased by 2.8 percent after the education reform in municipalities with high increases in high school availability relative to municipalities with low increases. This decline is not driven by a decline in the time teenagers had to engage in risky behaviors (incapacitation effect) but a potential change in expectations for the future.

JEL Classification: I12, I21, I28, J13, J16

Keywords: education reform, teenage birth rate, human capital

Corresponding author:
Mayra Pineda-Torres
School of Economics
Georgia Institute of Technology
221 Bobby Dodd Way NW
Suite 220, Atlanta
Georgia 30332
USA

E-mail: mpinedat@gatech.edu

* We thank Danielle Atkins, Daniel Dench, Sarah Komisarow, Jason Lindo, Caitlin Myers, Krishna Regmi, David Sappington, Andrea Velasquez, and participants at the Applied Economics Workshop at Vanderbilt University, the Research Seminar Series at American University, 2022 APPAM Fall Conference, 2023 Atlanta Athens Fall Conference, Atlanta Workshop on Public Policy and Child Well-Being, 3rd Annual South East Exchange of Development Studies Conference, 15th International Health Economics Association (IHEA) World Congress, 2023 Institute for Research on Poverty (IRP) Summer Research Workshop, and 2023 Southern Economic Association Annual Meetings, for helpful comments and suggestions. Any remaining errors are our own. The Estadística 911 data and population estimates used in this article are available upon request to the Ministry of Education and Mexican Population Council, respectively, through data request submissions at the Plataforma Nacional de Transparencia (https://www.plataformadetransparencia.org.mx/). Birth records are available online through the Health Information System from the Ministry of Health (http://www.dgis.salud.gob.mx/contenidos/sinais/subsistema1.html).

1 Introduction

Teenage pregnancy is a global issue, with 15 percent of women giving birth before age 18 globally (UNICEF, 2021). Teenage motherhood has been associated with lower educational attainment, labor force participation, and income (Hoffman et al., 1993; Bronars and Grogger, 1994; Klepinger et al., 1999; Chevalier et al., 2003; Levine and Painter, 2003; Fletcher and Wolfe, 2009), inferior marriage prospects (Hotz et al., 1997; Ermisch and Pevalin, 2005), higher reliance on cash assistance (Fletcher and Wolfe, 2009), and higher likelihood of falling below the poverty threshold (Schulkind and Sandler, 2019). Although teen birth rates have declined globally in the last few decades, the decline has been uneven in different regions of the world, and developing countries exhibit the highest rates worldwide. Because teenage pregnancy can change the course of a young woman's life and contribute to the inter-generational transmission of poverty, understanding its determinants is a key policy issue.[1]

Women may be more likely to embrace early childbearing in contexts where they perceive socioeconomic progress as not achievable. In contrast, when there is hope for economic and social advancement, delaying motherhood and investing in human capital can be more desirable (Kearney and Levine, 2012). Access to education can affect teen pregnancy in different ways. First, it may contribute to raising individuals' future earnings, increasing the opportunity cost of bearing children, and moving the optimal fertility choice towards fewer yet higher "quality" children (Becker, 1960).[2] Second, education can also provide teenagers with better information about contraception (Rosenzweig and Schultz, 1989) and may reduce their available time to engage in risky behaviors (Jacob and Lefgren, 2003). Moreover, education can affect the timing of fertility (Koebe and Marcus, 2020) and change women's preferences for partners, which may indirectly affect their fertility choices (Duflo

[1] Teen motherhood plays a role in the inter-generational transmission of poverty, as children born to teen mothers may achieve lower levels of education, have a higher probability of teenage childbearing, lower earnings (Francesconi, 2008), and a higher likelihood of engaging in criminal activity (Grogger, 1997).

[2] That is, children with, e.g., access to better education, nutrition, healthcare, and housing.

et al., 2021).

Educational choices and fertility decisions are likely to influence each other, making identifying the causal effect of education on teen pregnancy difficult. We examine the causal relationship between access to education and teenage pregnancy by focusing on a large-scale, country-wide, plausibly exogenous expansion in public high school capacity in Mexico, a middle-income country where teen pregnancy rates remain high.[3]

Starting in 2012, Mexico implemented an Education Reform that included high school as one of the compulsory levels of education in the Mexican Constitution. In this setting, the government committed to offering a seat in a public high school to any student of school age by eliminating existing capacity constraints through the improvements and expansions of the existing schools and opening of new ones.

Our empirical strategy leverages the heterogeneity in the implementation of the reform across municipalities and over time by comparing municipalities that experience large increases in high school availability (*high-exposure municipalities*) to municipalities with smaller changes in availability (*low-exposure municipalities*) in a difference-in-differences setting.[4] We combine different sources of information, including annual municipality-level administrative data on enrollment, number of schools, and births.

Our findings indicate that the reform increased the number of students by 7.5 percent in high-exposure municipalities relative to low-exposure municipalities. Moreover, we find that

[3]Latin America is one of the regions with the slower decline in teenage pregnancy, with a rate of 53.2 births per 1,000 teenagers in 2021 (World Health Organization, 2022). In 2019, for example, Mexico's rate was 58.4 births per 1,000 teenagers (15 to 19 years old). This rate is still higher than Canada's teen birth rate in 1960 (57.3) and the United States in 1973 (57.3), whose rates in 2019 were 6.8 and 16.4, respectively (World Bank, 2024). Figure A.1 in Appendix A shows the evolution of first birth rates (first parity) for teenagers (15-19), young non-teenage women (20-24), and all women of reproductive age (15-49) in Mexico. Although these birth rates have declined over time, first births to teenage mothers have consistently remained the highest, with an average of 53 births per 1,000 women between 2008 and 2019. This is followed by first births to women ages 20-24, with an average birth rate of 46 births per 1,000 women. The overall first birth rate of women of reproductive age has been, on average, 22 births per 1,000 women.

[4]We define as high-exposure municipalities those that experience a percentage increase in the average number of schools in 2013-2018, the post-reform period (relative to the average number in 2008-2012, the pre-reform period) above the cross-municipality median and an increase in 2013, the first year of implementation (relative to the year prior to the implementation, 2012) above the median. In addition, if a municipality opened its first school in 2013 or after, we consider this municipality to be high-exposure. In section 5.4, we show that the results are robust to considering alternative definitions of treatment.

teenage first births in high-exposure municipalities decreased by 2.8 percent after the reform, relative to low-exposure municipalities, implying that at least 23,091 teen births were avoided between 2014 and 2019 due to the increased access to high school. Our results are consistent with a decrease in teen births that is driven by teenagers changing their expectations for the future rather than an incapacitation effect (i.e., our results suggest that the effects on teenage childbearing are not driven by a reduction in the time adolescents have to engage in risky behaviors that increase the probability of early pregnancy). Importantly, we show that before the school capacity expansion, municipalities that later experienced large expansions in high school capacity were on similar teenage fertility trends as municipalities that received a lower expansion. This suggests that the intensity of the expansion in high school availability was not driven by strong demand for schooling in areas where teenage pregnancy was expected to decline.

Our paper contributes to the existing knowledge on the causal effects of education on fertility. Part of the literature provides evidence of this relationship by exploiting variation in educational attainment induced by differences in compulsory schooling regulations across regions and/or birth cohorts (Black et al., 2008; Monstad et al., 2008; DeCicca and Krashinsky, 2020; Alzúa and Velázquez, 2017; Wilson, 2017). In that case, the identified treatment effects are typically local to students who would drop out of school. In contrast, we exploit large expansions in high school capacity. In Mexico, the reform we analyze made high school education mandatory, but, in practice, there were no penalties for those who did not comply.[5]

[5]An essential element for compulsory education policies to provide plausibly exogenous variation in education is that compliance with such policies is extremely high. For example, Black et al. (2008) studied increases in mandatory educational attainment through compulsory schooling policies on teenage childbearing in the U.S. and Norway. In Black et al. (2011), they indicate compliance with the rule to start school in Norway when children turn seven was almost perfect for their studied cohorts. This is because otherwise, parents had to apply for an exception to the rule, which health and school specialists and the local government must approve. Similarly, DeCicca and Krashinsky (2020) study the effects of education on teenage fertility by relying on variation in education induced by compulsory schooling laws in Canada. They point out that some provinces, like Ontario, introduced penalties for non-compliance and hiring school-aged children. In contrast, in Mexico, the enforceability of high school education as compulsory has been less stringent. Teenagers not enrolling or dropping out of high school are not penalized, nor are their parents or tutors. Therefore, we claim the compulsory aspect of the reform is not the fundamental policy piece that changed educational opportunities but the ease of capacity constraints.

Then, our analysis is closer to papers that rely on school constructions as a source of variation in school access. In these studies, the treatment effects are more likely to be identified by the population of school-age individuals potentially affected by the expansion in school capacity without over-relying on students at the margin of dropping out.[6,7] With this paper, we present new evidence of how improving educational opportunities for teenagers through the expansion of high school access successfully retained them in the educational system and provided them with opportunities for social and economic advancement, resulting in the avoidance of early childbearing.

The remainder of this paper is organized as follows. In section 2, we discuss the characteristics of the Mexican education system and the education reform. In section 3, we describe our data sources. Section 4 discusses our identification strategy and estimation methods. In section 5, we discuss our main results. Section 6 concludes.

2 The Mexican educational system

The Mexican Educational System has a structure closely resembling the American system: it is divided into preschool, primary school, middle school, high school, and higher education. Primary school corresponds to grades 1 to 6, while middle and high school correspond to grades 7 to 9 and 10 to 12, respectively (SEP, 2013). In the last few decades, primary and middle school have been almost universally provided, but high school has not; it has been

[6]Studies using the variation of school availability include the analysis of access to tuition-free primary education in Nigeria in the context of a program that expanded the primary classrooms; the effect of primary school construction in Indonesia (Breierova and Duflo, 2004; Akresh et al., 2022; Mazumder et al., 2023), and, closer to our setting, the impact of the construction of secondary schools in Brazil (Foureaux Koppensteiner and Matheson, 2020). Our study differs from the latter in that the change in school access was induced by an education reform implemented as part of the policy changes that came with the newly elected president's term initiated in 2013. This was an unforeseen reform, as it was never disclosed during his political campaign. Moreover, the expansion of school capacity represents a large-scale, rapid shock to high school education as it mainly relied on the existing school infrastructure and resources across municipalities. In addition, we explore an incapacitation effect as a potential mechanism behind our findings and show that it does not explain the decline in teen births, suggesting a change in expectations for the future as a potential mechanism.

[7]Our results also contribute to the understanding of how changes in the effective costs of attending school affect early fertility. The literature on this matter includes the effects of access scholarships or cash transfer programs (Baird et al., 2010; Duflo et al., 2015, 2021).

subject to capacity constraints, with students having to undergo a competitive application process.

Mexico's public high school education system includes three school types or degrees that students can apply to. General high schools resemble high schools in the U.S. by preparing students for undergraduate studies and are usually run by universities. This is the traditional high school type. Technical schools provide high school curricula and classes that aim to prepare students for the labor market. These are smaller high schools with technical classes such as industrial chemistry, gastronomy, and I.T. support. Finally, vocational schools are purely professional and do not provide a high school diploma. Instead, they offer plumbing, carpentry, and welding degrees, among others (SEP, 2013).

Relative to elementary and middle schools, high school was not widely available historically. Therefore, the process of entering a public high school is competitive. After middle school, students apply to high schools. Depending on the region, high school applications and admissions are based on the GPA or standardized test scores. In Mexico City's Metropolitan Area, for example, the Council of High Schools (Comisión Metropolitana de Instituciones Públicas de Educación Media Superior, COMIPEMS) runs a centralized high school admission process for public schools, where a placement exam score is the only determinant of admission. In each application system, prospective students are ranked and assigned to schools according to their school preference, seats available in each school, and their position in the ranking. Before the reform, students were required to score above a point cutoff (at least 31 points) in the placement exam to be considered for admission. After the reform, the minimum score requirement was eliminated.[8]

[8]The press release for the results of the 2013 high school standardized test contest in Mexico City provides information on how the reform came to be included in this contest. For example, it indicates that *"... the goal of this contest is the school seats distribution and assignment, not evaluating the performance of prospective students."* In addition, *"... no prospective student was assigned to a non-chosen option, and the requirement for a minimum point cutoff was eliminated to be consistent with the compulsory high school constitutional reform."* It also details what options non-matched students had: *"... students with an insufficient score to be matched to their preferred options or who did not meet the minimum GPA of 7 to attend a high school from the Universidad Nacional Autónoma de México or Instituto Politécnico Nacional, have the option to choose one of the remaining available seats in other schools."*(Secretaría de Educación Pública, 2013a).

Unlike the U.S., students are not restricted to school districts of residence and may apply and, if admitted, enroll in any school in the country with available seats. Neither is the funding tied to the district. The majority of the funds for education come from the federal government, although states and municipalities also contribute. In the past, students who were not matched to any of their chosen schools (or did not achieve the minimum admission requirements) could not be admitted to any public high school. This meant these students would have to reapply the following school year or abandon the educational system. However, as described in the following subsection, the education reform reduced capacity constraints and enhanced students' opportunities to attend public high schools.

2.1 The reform to high school education

By 2012, compulsory education in Mexico included preschool, elementary school, and middle school.[9] That year, the Mexican Constitution was modified to include high school as one of the compulsory levels of education.[10] Starting in the 2012-2013 academic year, the government had the obligation and commitment to guarantee access to public high school education to any student completing the basic education and of age to attend high school. The goal was accomplishing full coverage of all the students of age to attend high school by the 2021-2022 school year (Miranda López, 2018).

In February 2013, the Education Reform Act (ERA) introduced by former President Enrique Peña Nieto (EPN) was declared constitutional and signed into law. The ERA included major reforms to the educational system in Mexico; high school education was no exception. Building onto the 2012 reform to Article 3, the Education Sectoral Program 2013-2018 (Programa Sectorial de Educación 2013-2018, in Spanish) (Secretaría de Educación Pública, 2013b), one of the elements of the ERA, established the need to open new schools,

[9] These three levels of education integrate the basic education in Mexico.

[10] On February 9, 2012, high school as a compulsory level of education was included in the first paragraph of Article 3 in the Mexican Constitution: "*All individuals have the right to receive an education. The Federal government, states, and municipalities will provide preschool school, elementary school, middle school, and* ***high school****. Preschool education, elementary school, and middle school are the basic education;* ***this and high school are compulsory.***" (Diario Oficial de la Federación, 2012).

improving and expanding existing schools, and providing virtual education (Prepa en línea SEP) and the open high school education mode.[11] These additional educational modes allowed the expansion and diversification of options to attend the new high school demand (Mendoza Rojas, 2018).[12] With the ERA, capacity constraints decreased. Even students not assigned to a public high school of their choice through the matching system would be given a seat in another school or could continue their education in one of the alternative modes.

Figure 1 shows the evolution of the average number of high school and enrolled students in a municipality from 2008 to 2018. Although both have increasing trends over time, they also show a sharp increase between the 2012-2013 and 2013-2014 school years, the latter being the first school year affected by the reform. In particular, the average number of schools in a municipality increased from around 6.2 in the 2012-2013 school year to around 7.5 schools in 2013-2014, but for the subsequent years, it became closer to 10 schools, on average. Likewise, the average number of high school students across municipalities in the school year before the reform was around 1,650. Once the reform was implemented, this average increased by approximately 300 students; by 2018, it was above 2,200. This figure provides suggestive evidence of a sharp jump between 2012 and 2013 and a sustained increase in high school availability and capacity, reflected in newly available capacity and higher enrollment after the reform implementation.

Although Article 3 in the Mexican Constitution states that high school education is compulsory, in practice, high school-age individuals not complying with the law (or their parents

[11]This education mode allows students to initiate or continue high school at their own pace. Students can enroll in open high schools anytime without an admission test. There are no age or time limitations to completing the study plan. After concluding the study plan, students receive an open high school certificate.

[12]The Education Sectoral Program recognized that expanding capacity was not enough to improve students' retention and recognized the importance of minimizing the number of students dropping out of high school. It was fundamental to improve the study plan quality, standardize the study plan quality across the different high school types, and provide tools and knowledge useful for students joining the labor market after high school. It also established the importance of communication between parents and the school system to obtain their support in their children's education and, ultimately, contribute to minimizing the risk factors that affect students' ability to stay in high school. The Education Sectoral Program was also considered a priority for teachers' professional development so that they were trained and prepared to address the changes to the educational system the ERA would bring and attend to the new high school demand (Secretaría de Educación Pública, 2013b).

or tutors) are not penalized. As we show in section 5.1, the reform greatly impacted the number of high schools and enrollment, causing a shock to the supply of high school education in Mexico that had not been seen before. Even though the compulsory aspect of the law may not be the fundamental factor behind high school enrollment, capacity constraints have prevented teenagers of school age from enrolling in high school. In other words, teenagers may have wanted to attend high school even before it was compulsory, but capacity constraints prevented them from doing so.

Another interesting aspect of the ERA is how it came to be implemented. It passed in the first few months following the election of the former president, EPN, and it was not discussed throughout his political campaign. Given the short legislative process and the restricted debate preceding it, the ERA also represents a shock with no anticipation effects. Moreover, during EPN's tenure, the other major reforms focused on the tax system, the regulation of the electricity and oil sectors, labor law, and political reforms that included changes to the legislative procedure. Since none of these changes indirectly affect the educational system, it is unlikely these other policies drove the changes in enrollment after 2013 we identified. Moreover, if these other reforms impacted fertility, we would likely observe changes in fertility across age groups and municipalities, not only in teenagers living in municipalities with higher exposure to the education reform, as shown in section 5.2.

3 Data

To explore changes in public high school education availability, we rely on school-level administrative census data from Estadistica 911 collected by the Ministry of Education directly from high schools at the beginning of each academic year. We focus on analyses at the municipality level since this is the smallest government level at which decisions on the budget for education are made.[13] We restrict our analysis to the information for the academic years

[13]The federal contributions to the General Branch 33 from the Federal Expenditure Budget (Ramo 33 del Presupuesto de Egresos de la Federación, in Spanish) are established as the resources the Federal government

2008/09-2018/19.

Information on births comes from the Birth Information Subsystem (Subsistema de Información sobre Nacimientos, SINAC, in Spanish) (Secretaría de Salud, 2022) from the Ministry of Health, which contains data on all the birth certificates issued at birth occurrence between 2008 and 2019. This information is collected by hospitals and health facilities and reported to the Health Ministry for its validation and compilation, and it has been available since 2008 (Instituto Nacional de Estadística, Geografía, e Informática, 2020). We aggregate birth records by mothers' municipality of residence, quinquennial age groups, and year. Because the impact on women's schooling decisions is more likely to be pronounced with the birth of their first child compared to subsequent children, we restrict our main analyses to the sample of first births.

We also rely on the annual estimates of the total population and population by sex and age group at the municipality level from the National Population Council (Consejo Nacional de Población, CONAPO, in Spanish).

4 Empirical strategy

Although the education reform was a national policy, in practice, teenagers' exposure to the reform varies due to differences in the allocation of resources to public education across municipalities. Using a difference-in-differences framework, we exploit the variation in the intensity of exposure to the reform at the municipality level to study its impacts on teenage birth rates.

transfers to state and municipality treasuries to allocate to expenses in public education, health, infrastructure, public security, and social welfare programs. In particular, the public education budget allocation covers expenses related to education provision, infrastructure, teacher and staff training, and compensation packages (Martínez Vargas, 2020).

4.1 Intensity of exposure to the education reform

We define the intensity of exposure to the education reform of municipality m based on two elements. First, we consider the percentage change in the number of schools between 2012 and 2013 to capture the discontinuity in school availability as a response to the reform.

$$Growth_m^{12-13} = \frac{S_m^{2013} - S_m^{2012}}{S_m^{2012}} \tag{1}$$

Where S_m^{2012} and S_m^{2013} are the number of high schools in municipality m in 2012 and 2013, respectively.[14]

Second, we account for the relative and sustained growth in the number of schools pre-post reform to capture the change in school availability that persists over time once school capacity is expanded through the reform.

$$Growth_m^{pre-post} = \frac{S_m^{\bar{post}} - S_m^{\bar{pre}}}{S_m^{\bar{pre}}} \tag{2}$$

Where $S_m^{\bar{pre}}$ and $S_m^{\bar{post}}$ are the average number of high schools in municipality m before and after the reform took place in 2013, respectively; that is, the municipality's average number of schools between 2008-2012 and 2013-2018, respectively.

A municipality m is defined as being highly exposed to the education reform if both $Growth_m^{12-13}$ and $Growth_m^{pre-post}$ are *above the corresponding median* of the distributions across municipalities.[15] Using this information, we construct an indicator variable for municipalities with high exposure ($HighExposure_m$) to the reform and zero otherwise. The intuition behind this definition of treatment is that the sharp and persistent change in available schools in a municipality after the reform is likely to be exogenous to the teenagers in the age range to attend high school. In the remainder of the paper, we will refer to municipalities with high exposure to the reform as high exposure. We will denote the rest of the municipalities as low-exposure municipalities.[16]

[14] In our analysis, when a high school has multiple shifts, the number of schools is defined as the number of shifts in that high school.

[15] In addition, if a municipality opened its first school in 2013 or after, we consider this municipality as being treated.

[16] In section 5.4, we present results by varying the cutoff to define what municipalities are treated according

Figure 2 shows the yearly average number of students enrolled in high schools in low and high-exposure municipalities. The red triangles represent the average for high-exposure municipalities, and the blue circles show the average for low-exposure municipalities. Prior to the education reform, the difference in the average number of high school students between high-exposure and low-exposure municipalities exhibited a persistent gap. However, this gap significantly increased starting in 2013. This figure suggests that the reform implementation was not homogeneous across the country and that the changes in enrollment in low-exposure municipalities provide a good counterfactual for the corresponding changes in high-exposure municipalities.

Figure 3 presents a map with the distribution of high-exposure and low-exposure municipalities across the country: 511 municipalities (21 percent) fall within the first category, and 1,945 (79 percent) fall within the second category. As the map reveals, there is variation across the country's regions in municipalities' exposure to the reform.

Why some municipalities were more affected by the reform than others? Figure A.2 in the Appendix shows that even before the implementation of the reform, high-exposure municipalities had an average number of schools above the average in low-exposure municipalities. This implies that areas, where high school availability was already higher, are those that were more affected by the reform. This is likely explained by the high school education goals in the Education Sectoral Program, which mainly targeted the implementation of reform through the use and expansion of the existing infrastructure and resources (Secretaría de Educación Pública, 2013b).[17]

to their locations in the schools' growth distributions. In particular, we show results varying the cutoffs for municipalities with a growth in the number of schools in the 40, 45, and 55 or above percentiles. Although some results become noisier, the main findings hold under these different high-exposure definitions.

[17]The Education Sectoral Program emphasized the necessity of increasing high school coverage by taking advantage of the existing resources. Selected excerpts from this Program highlight that: *"Resources are scarce. So, it will be necessary to take advantage of the existing capacity and simultaneously increase and diversity the education supply with new education types." "It is a challenge to increase the education supply. Therefore, it is fundamental to improve education planning capacity. Increases in capacity should respond to the best possible use of existing resources."* The strategies to achieve the goals of this program regarding high school education included the prioritization of investments aimed at expanding physical infrastructure in schools that had space and whose educational model allowed it, the promotion of programs that fully took advantage of the available capacity in existing infrastructure, and the promotion of federal financial support

4.2 Estimation Method

We explore the effects of the education reform on teenage birth rates by leveraging variation in the municipality's exposure to the reform. We compare the number of births of women in population group g in municipalities with low vs. high exposure to reform by estimating the following Poisson model by Pseudo-Maximum Likelihood:[18]

$$E[Births_{gmrt}|HighExposure_{mt}, \alpha_m, \alpha_{rt}, pop_{gmt}] = exp\left(\sum_{j=-6}^{j=5} \delta_j HighExposure_{mt}^{j} + \alpha_m + \alpha_{rt} + 1ln(pop_{gmt}) + \epsilon_{gmrt}\right) \quad (3)$$

where $Births_{gmrt}$ represents the number of first births of women in age group g, living in municipality m, region r, and year t, α_m are municipality fixed effects, $HighExposure_{mt}^{j}$ indicates if municipality m is high-exposure j periods from the reform year (2014) and zero otherwise, and ϵ_{gmrt} is an error term that we allow to be correlated within municipalities.[19] We control for the population of women, pop_{mgt}, in age group g, municipality m, and year t, as the exposure variable and restrict its coefficient to be unity.[20] We also include region-by-year fixed effects, α_{rt}, to compare changes in outcomes in high and low-exposure municipalities within the same region.[21]

We omit the year before the policy change as the comparison year. The parameter δ_j indicates the average impact of the reform on the rate of first births of women in age group

for education options that offered better results in relation to costs.

[18] We consider quinquennial age groups: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49.

[19] We define 2014 as the first year affected by the reform to account for a nine-month pregnancy period.

[20] Algebraically, by including as the exposure variable the log of the corresponding population and constraining its coefficient to be equal to 1, this is equivalent to having the birth rate as a ratio of the population of women as the dependent variable. We implement this estimation using the *ppmlhdfe* Stata command with the relevant population in the *exposure* option.

[21] We consider Mexico's eight regions: northeast, northwest, north-center, south-center, east, west, southeast, and southwest.

g, black j years later. We also estimate a static version of equation (3) as follows:

$$E[Births_{gmrt}|HighExposure_{mt}, \alpha_m, \alpha_{rt}, pop_{gmt}] = \\ exp\left(\delta HighExposure_{mt} \times Post_t + \alpha_m + \alpha_{rt} + 1ln(pop_{gmt}) + \epsilon_{gmrt}\right) \quad (4)$$

where $Post_t$ is an indicator variable for the period 2014-2019. The remaining variables are the same as those in equation (3). In this case, δ recovers the average effect of the reform on the first birth rates of women in age group g.

The identifying assumption underlying our research design is that in the absence of the education reform, teenage birth rates in high and low-exposure municipalities (within the same region) would have followed the same trends in the years after the reform. We provide empirical evidence supporting this assumption in section 5.

5 Estimated Results

5.1 Impacts of the education reform on high school capacity

For the education reform to change teenage fertility trends, municipalities must expand their high school availability, and teenagers must perceive these changes in educational opportunities and take advantage of them, which would reflect increases in enrollment. In section 4.1, we presented suggestive evidence of differential trends after 2013 in the high school enrollment between high-exposure and low-exposure municipalities. We formalize this evidence in Figure 4, which shows the event-study estimates corresponding to a slightly modified version of equation (3) in which the outcome variable is the number of students enrolled in high school.[22]

Before the reform, enrollment followed similar trends in high-exposure and low-exposure

[22]In this case, the post-reform period starts in 2013, when the expansion of high school availability started. Since we consider data on school enrollment for 2008/09-2018/19, we recover the estimated effects for $j \in [-5, +5]$. In addition, the exposure variable in this analysis is pop_{mt}, the population of teenagers in municipality m in year t.

municipalities, providing support for the parallel trends assumption. Estimates show that after the reform, enrollment increased by 6.5 percent in 2013 in high-exposure municipalities relative to low-exposure municipalities, and this increase is statistically significant at the 1 percent level.[23] The average increase in enrollment in the post-reform period is approximately 7.5 percent.

We also examine if the education reform affected the enrollment decisions of males and females differently. Figure 5 shows the event-study estimates by sex. The estimates and corresponding confidence for males and females overlap, suggesting that males and females took advantage of the expansion in high school capacity similarly.

5.2 Impacts of the education reform on teenage birth rates

In our analysis of the effect of the expanded high school availability on first births, we focus on three age groups: 15-19 years old (teenagers), 20-24 years old (non-teenage young women), and 15-49 years old (all women of reproductive age).[24] We expect to observe the changes in first births to be concentrated in the 15-19-year-old women group since they are the ones of age to attend high school. In addition, as most 20-24-year-old women in our analysis were not directly exposed to the reform, we expect the reform to have negligible or significantly smaller effects on this group than on the 15-19-year-old women.

Since the education reform should have only affected the fertility of women of high school age, overall birth trends are unlikely to change significantly between high vs. low-exposure municipalities after the reform, other than due to its effect on high-school-aged women. Otherwise, our estimates could capture other factors that generate differential trends between high and low-exposure municipalities besides the education reform.

Before discussing the estimated effects of the education reform on (first) teen births, we present descriptive information on the evolution of first birth rates by females' age group

[23] Figure 4 shows an increase in enrollment of 6.5 percent: $[exp(0.063) - 1] \times 100$.

[24] The group of all women of reproductive age contains information for the following quinquennial age groups: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49.

across municipalities' exposure to the education reform in Table 1. For the period included in our analysis (2008-2019), high-exposure municipalities have higher first birth rates for these three groups of women relative to low-exposure municipalities. However, the difference is relatively small. Birth rates by age group and for all women of reproductive age show a decline after the reform (2008-2013 vs. 2014-2019) for all age groups in high and low-exposure municipalities. Nonetheless, first-birth rates declined more after the reform in high-exposure municipalities than in low-exposure municipalities. In particular, teen first birth rates in low-exposure municipalities went from 52.7 to 50.5 births per teenage women, whereas in high-exposure municipalities, they declined from 55.9 to 51.6. We observe a similar pattern for the 20-24 age group, although the difference in birth rate declines between low vs. high-exposure municipalities is more modest.

Figure 6 shows event-study figures corresponding to the estimates of δ_j in equation (3). Panel (a) presents the estimates for the first births of all women of reproductive age. The estimated results show that the education reform did not differentially change birth trends across municipalities. The point estimates in the post-reform period are negative but insignificant. A potential explanation for this is that the reform negatively impacted teenage pregnancy jointly with no effect on older women's fertility. We examine this possibility by estimating the model for women in different age groups.

Panel (b) restricts the sample to births of 15-19 years old and confirms the effects of the reform on fertility are concentrated among teenagers. Before the education reform, first births to teenagers trended similarly across high- and low-exposure municipalities, which provides evidence that supports the validity of our parallel trends assumption. However, once the reform was implemented, teen births decreased more in high-exposure municipalities than in low-exposure municipalities. Although births show a lagged response to the reform, on average, they decreased by 3.8 percent in high-exposure vs. low-exposure municipalities three to five years after the reform. Panel (c) shows the estimates for the sample of first births to 20-24-year-old women. The reform did not change this group's birth trends in high

vs. low-exposure municipalities. Figure A.3, in Appendix A, shows the event studies for 25-29 and 30-49-year-old women. As expected, first births to these women were not affected by the education reform.

Table 2 presents the estimated average effects of our specification in equation (4), considering all women of reproductive age (column 1), 15-19-year-old women (column 2), and 20-24-year-old women (column 3). The estimated effects indicate that the education reform decreased first teen births by 2.8 percent in high-exposure municipalities relative to low-exposure municipalities.[25] In the case of first births of all women of reproductive age and 20-24-year-old women, the education reform does not induce statistically significant changes at conventional significance levels.

5.3 Future opportunities vs. contemporary incapacitation

With the education reform, teenagers who would not have been able to attend a public high school before had the opportunity to enroll, thanks to the easing of capacity constraints. However, the reduction in teenage fertility may be driven by several factors. On the one hand, students may perceive the expansion in educational opportunities as a means of social and economic advancement, which changes their expectations and aspirations for the future and incentivizes them to avoid early fertility. On the other hand, the reform may not have changed students' expectations for the future and only represents an incapacitation effect. So, when teenagers are out of school, they may still engage in risky behaviors that increase the chances of an early birth.

To examine these possibilities, we test for differences in the effects on summer pregnancies, defined as first births with an associated month of conception during June to August (i.e., when teenagers are not "incapacitated" in school) and non-summer pregnancies (first births with an associated month of conception during the rest of the year). We calculate each pregnancy's approximate conception date using information on the birth date and weeks of

[25] $[exp(-0.028) - 1] \times 100 = 2.76$

gestation. If the reform had only affected non-summer pregnancies, this would suggest that our results are likely to be explained by an incapacitation effect for teenagers rather than a change in their aspirations for the future.

Figure 7 shows the event studies for teenage births with associated summer and non-summer pregnancies. Although the event study for summer pregnancies is noisier due to fewer births happening in these months than the rest of the year, this figure provides evidence of no differences in the effects between teenage pregnancies during and out of the school year. This suggests that students were no more likely to engage in risky sexual behaviors during the summer than the rest of the year. Therefore, the increase in access to high school is likely to have been perceived by teenagers as a potential improvement in their future social and economic opportunities.

5.4 Robustness checks

Our identification relies on a definition of treatment (i.e., high-exposure municipalities) that uses a threshold considering both the increased access to high school during the first year of the education reform and the sustained growth in high school access over time. By construction, however, the group of low-exposure municipalities includes areas treated to a lesser extent. This implies that our estimated results should be interpreted as lower bounds for the effects of the education reform on teenage pregnancy. We illustrate this idea and show robustness to our results by following two strategies. First, we show how our estimates change when we vary the treatment threshold. Second, we exclude from the control group sets of municipalities that are more likely to be significantly affected by the reform (i.e., municipalities with growth in high school access closer to the threshold).

In our treatment definition, we consider a municipality as highly exposed to the reform if both the relative growth in the number of schools pre-post reform and the relative growth in the number of schools between 2012 and 2013 are above the median (i.e., the percentile 50) in their corresponding distributions. We test the robustness of our estimates to changes

in the distribution thresholds for a municipality to be considered highly exposed to education reform. In particular, we redefined the rule for a municipality to be considered treated by setting the treatment inclusion criteria that the municipality's number of schools' relative growths are above the percentile x in the corresponding growth distributions, where $x = 40, 45, 55$. Panel (a) of Table 3 shows the estimated effects of these alternative definitions of treatment. The results show that after the reform implementation, teenage first births declined in high-exposure municipalities relative to low-exposure in all the cases. However, the more restrictive the threshold becomes (i.e., the higher the x), the less likely we can identify statistically significant effects of the reform on teenage birth because the control groups contain municipalities with higher exposure to the reform relative to when the threshold is less restrictive (i.e., $x = 40, 45$).[26]

We also redefine what municipalities we consider as low-exposure. In particular, we excluded municipalities whose schools' growth was close to the 50th percentile to reduce the potential contamination in the comparison group. We exclude municipalities with growths in the number of schools between 45-50, 40-50, and 35-50 percent. For example, in the last case, we consider high-exposure municipalities with a growth in the number of schools above the 50th percentile in the growth distributions vs. municipalities with a growth in the number of schools below the 35th percentile. Then, using these comparison groups, we estimate the effects on teenage first births using equation (4). The estimated effects are shown in panel (b) of Table 3. The results show that the estimated effects of the education reform on teenage births are robust to excluding these municipalities from the comparison group and that as we get a cleaner counterfactual, the estimated effects on birth rates increase from 2.8 to 5.1 percent when we exclude growths between 35 and 50 percent from the control group.[27]

Finally, as non-school-age women are more likely to have had children in the past than teenagers, in Table B.1, we estimate the effects of the reform considering subsequent births

[26]Figure A.4 in Appendix A shows the event studies for each of the different thresholds.

[27]Figure A.5 in Appendix A shows the event studies varying the municipalities considered low-exposure according to their location in the growth distributions.

(i.e., not-first births). We find that the reform did not affect the births among females who already had children. This is true both for teenagers and older women. These results suggest that increased access to high school education reduced teenage births among those who did not have children before the program's implementation. These results make sense since teenagers and older women who already had children are expected to be less affected by a high school reform because they are less likely to continue their educational investments as a response to the reform relative to childless teenagers.

6 Conclusions

We explore the causal relationship between educational attainment and teenage birth rates by focusing on a large-scale, country-wide, exogenous shock to public high school capacity. This shock eased high school capacity constraints by constructing new schools and creating new shifts in the existing ones.

Although the education reform was a national policy, its implementation was not homogeneous across the country due to differences in capacity and budget constraints at the municipality level. Using a differences-in-differences approach, we exploit these differences in municipalities' exposure to the reform. This reform increased enrollment by 7.5 percent in high-exposure municipalities relative to low-exposure municipalities. Moreover, birth rates of 15-19-year-old women decreased by 2.8 percent in high-exposure municipalities relative to low-exposure municipalities. As a consequence of the improved high school access, 1,124,465 additional students enrolled in high school during the 2008/09-2018/19 period, and at least 23,091 births to teenagers were avoided. This implies that for every 100 students (45 females and 55 males) who gained access to high school in the context of the reform, two births to teenage women were avoided. We do not observe statistically significant changes in the number of births for other age groups after the reform.

These findings shed light on the importance of providing teenagers with educational op-

portunities that can change their expectations and aspirations for the future and incentivize them to delay parenthood and continue their human capital investments. In the context of the U.S., previous research has suggested that policies specifically aimed at preventing teen pregnancy, such as sex education or increased access to contraception, are unlikely to considerably improve outcomes for disadvantaged teenage women; however, policies improving economic opportunities, reducing poverty, and improving prospects for adulthood have more potential to decrease teenage fertility (Kearney and Levine, 2012). In particular, financial aid for higher education and early childhood education programs have been identified as interventions that could effectively reduce teen pregnancy (Levine and Zimmerman, 2010). In this paper, we present evidence of an education policy targeting teenagers that successfully created opportunities for them and retained them in school, potentially changing their aspirations and expectations for the future and ultimately reducing early births.

References

Akresh, R., Halim, D., and Kleemans, M. (2022). Long-Term and Intergenerational Effects of Education: Evidence from School Construction in Indonesia. *The Economic Journal*, 133(650):582–612.

Alzúa, M. L. and Velázquez, C. (2017). The effect of education on teenage fertility: causal evidence for Argentina. *IZA Journal of Development and Migration*, 7(7). Publisher: Springer.

Baird, S., Chirwa, E., McIntosh, C., and Özler, B. (2010). The short-term impacts of a schooling conditional cash transfer program on the sexual behavior of young women. *Health Economics*, 19(S1):55–68.

Becker, G. S. (1960). An Economic Analysis of Fertility. In *Demographic and Economic Change in Developed Countries*, pages 209–240. Columbia University Press.

Black, S. E., Devereux, P. J., and Salvanes, K. G. (2008). Staying in the Classroom and out of the Maternity Ward? The Effect of Compulsory Schooling Laws on Teenage Births. *The Economic Journal*, 118(530):1025–1054. Publisher: [Royal Economic Society, Wiley].

Black, S. E., Devereux, P. J., and Salvanes, K. G. (2011). Too Young to Leave the Nest? The Effects of School Starting Age. *The Review of Economics and Statistics*, 93(2):455–467. Publisher: The MIT Press.

Breierova, L. and Duflo, E. (2004). The Impact of Education on Fertility and Child Mortality: Do Fathers Really Matter Less Than Mothers? NBER Working Papers 10513, National Bureau of Economic Research, Inc.

Bronars, S. and Grogger, J. (1994). The Economic Consequences of Unwed Motherhood: Using Twin Births as a Natural Experiment. *American Economic Review*, 84(5):1141–56. Publisher: American Economic Association.

Chevalier, A., Viitanen, T. K., and Viitanen, T. K. (2003). The long-run labour market consequences of teenage motherhood in Britain. *Journal of Population Economics*, 16(2):323–343. Number: 2 Publisher: Springer.

DeCicca, P. and Krashinsky, H. (2020). Does education reduce teen fertility? Evidence from compulsory schooling laws. *Journal of Health Economics*, 69:102268.

Diario Oficial de la Federación (2012). DECRETO por el que se declara reformado el párrafo primero; el inciso c) de la fracción II y la fracción V del artículo 3o., y la fracción I del artículo 31 de la Constitución Política de los Estados Unidos Mexicanos.

Duflo, E., Dupas, P., and Kremer, M. (2015). Education, HIV, and Early Fertility: Experimental Evidence from Kenya. *American Economic Review*, 105(9):2757–97.

Duflo, E., Dupas, P., and Kremer, M. (2021). The Impact of Free Secondary Education: Experimental Evidence from Ghana. Working Paper 28937, National Bureau of Economic Research. Series: Working Paper Series.

Ermisch, J. and Pevalin, D. J. (2005). Early Motherhood and Later Partnerships. *Journal of Population Economics*, 18(3):469–489. Number: 3 Publisher: Springer.

Fletcher, J. M. and Wolfe, B. L. (2009). Education and labor market consequences of teenage childbearing: Evidence using the timing of pregnancy outcomes and community fixed effects. *The Journal of Human Resources*, 44(2):303–325.

Foureaux Koppensteiner, M. and Matheson, J. (2020). Secondary Schools and Teenage Childbearing: Evidence from the School Expansion in Brazilian Municipalities. *The World Bank Economic Review*, 35(4):1019–1037.

Francesconi, M. (2008). Adult Outcomes for Children of Teenage Mothers. *The Scandinavian Journal of Economics*, 110(1):93–117. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-9442.2008.00526.x.

Grogger, J. (1997). Incarceration-Related Costs of Early Childbearing. In *Kids Having Kids*. Routledge. Num Pages: 25.

Hoffman, S. D., Foster, E. M., and Furstenberg, F. F. (1993). Reevaluating the Costs of Teenage Childbearing: Response to Geronimus and Korenman. *Demography*, 30(2):291–296. Number: 2.

Hotz, V. J., McElroy, S. W., and Sanders, S. G. (1997). The Impacts of Teenage Childbearing on the Mothers and the Consequences of Those Impacts for Government. In *Kids Having Kids*. Routledge. Num Pages: 40.

Instituto Nacional de Estadística, Geografía, e Informática (2020). Subsistema de Información sobre Nacimientos.

Jacob, B. A. and Lefgren, L. (2003). Are Idle Hands the Devil's Workshop? Incapacitation, Concentration, and Juvenile Crime. *American Economic Review*, 93(5):1560–1577.

Kearney, M. S. and Levine, P. B. (2012). Why Is the Teen Birth Rate in the United States So High and Why Does It Matter? *Journal of Economic Perspectives*, 26(2):141–163.

Klepinger, D., Lundberg, S., and Plotnick, R. (1999). How Does Adolescent Fertility Affect the Human Capital and Wages of Young Women? *Journal of Human Resources*, 34(3):421–448. Number: 3 Num Pages: 28.

Koebe, J. and Marcus, J. (2020). The Impact of the Length of Schooling on the Timing of Family Formation. Discussion Papers of DIW Berlin 1896, DIW Berlin, German Institute for Economic Research.

Levine, D. I. and Painter, G. (2003). The Schooling Costs of Teenage Out-of-Wedlock Childbearing: Analysis with a Within-School Propensity-Score-Matching Estimator. *The Review of Economics and Statistics*, 85(4):884–900. Number: 4.

Levine, P. B. and Zimmerman, D. J. (2010). *Targeting Investments in Children: Fighting Poverty When Resources are Limited*. University of Chicago Press. Backup Publisher: National Bureau of Economic Research Type: Book.

Martínez Vargas, T. (2020). El gasto en educación.

Mazumder, B., Rosales-Rueda, M. F., and Triyana, M. (2023). Social interventions, health, and well-being. *Journal of Human Resources*, 58(4):1097–1140.

Mendoza Rojas, J. (2018). Situación y retos de la cobertura del sistema educativo nacional. *Perfiles educativos*, 40(spe):11–52.

Miranda López, F. (2018). Abandono escolar en educación media superior: conocimiento y aportaciones de política pública. *Sinéctica*, (51).

Monstad, K., Propper, C., and Salvanes, K. G. (2008). Education and fertility: Evidence from a natural experiment. *The Scandinavian Journal of Economics*, 110(4):827–852.

Rosenzweig, M. R. and Schultz, T. P. (1989). Schooling, Information and Nonmarket Productivity: Contraceptive Use and Its Effectiveness. *International Economic Review*, 30(2):457–477. Publisher: [Economics Department of the University of Pennsylvania, Wiley, Institute of Social and Economic Research, Osaka University].

Schulkind, L. and Sandler, D. H. (2019). The Timing of Teenage Births: Estimating the Effect on High School Graduation and Later-Life Outcomes. *Demography*, 56(1). Number: 1.

Secretaría de Educación Pública (2013a). Comunicado 109.- Resultados del Concurso de Ingreso al Bachillerato de la Zona Metropolitana de la Ciudad de México.

Secretaría de Educación Pública (2013b). Programa sectorial de educación 2013 - 2018.

Secretaría de Salud (2022). Subsistema de Información sobre Nacimientos (SINAC).

SEP (2013). Sistema educativo de los Estados Unidos Mexicanos, principales cifras del sistema educativo nacional 2012-2013. Technical report.

UNICEF (2021). Early childbearing.

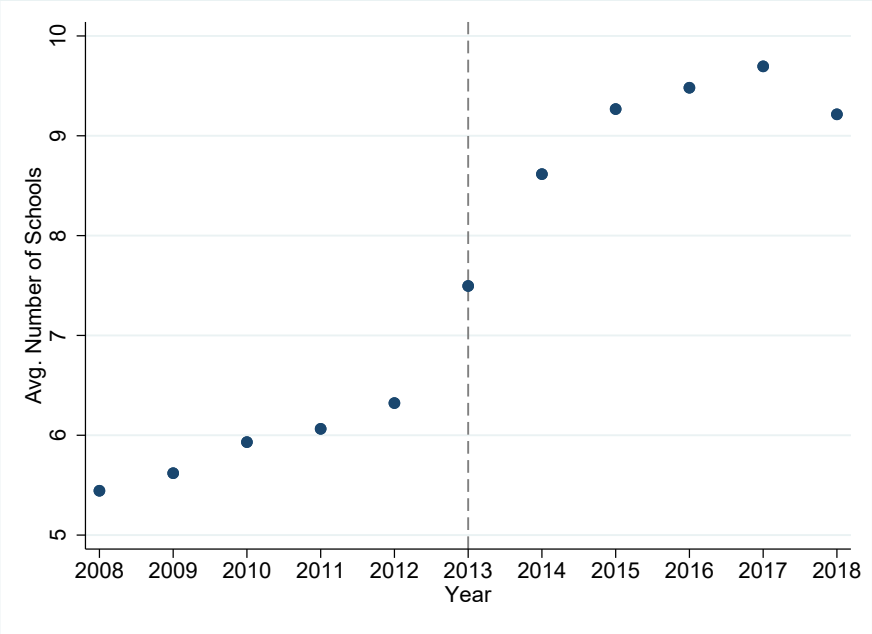
Wilson, T. (2017). Compulsory Education and Teenage Motherhood. Working Paper.

World Bank (2024). World Bank Open Data.

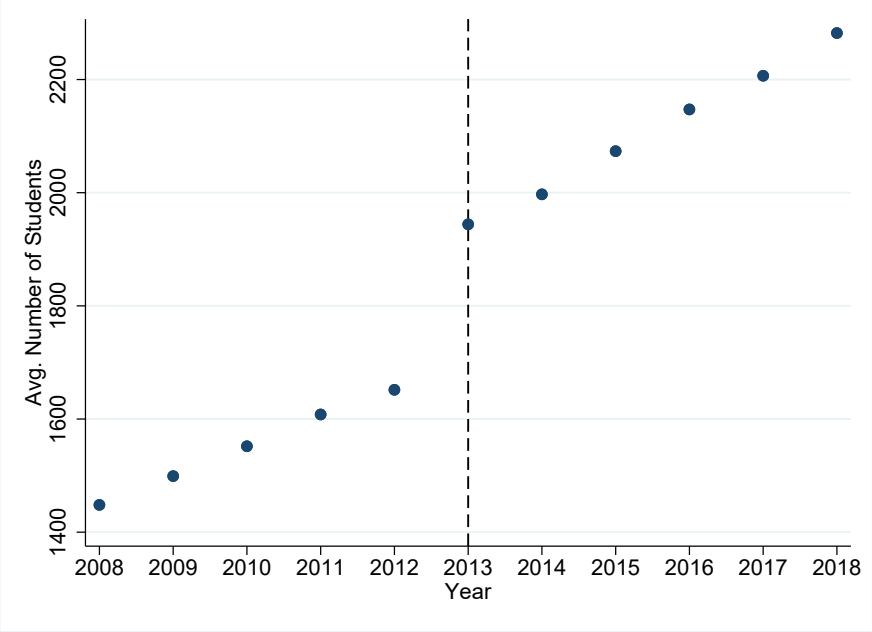
World Health Organization (2022). Adolescent pregnancy.

Figure 1: Municipalities' average number of schools and students

(a) Schools

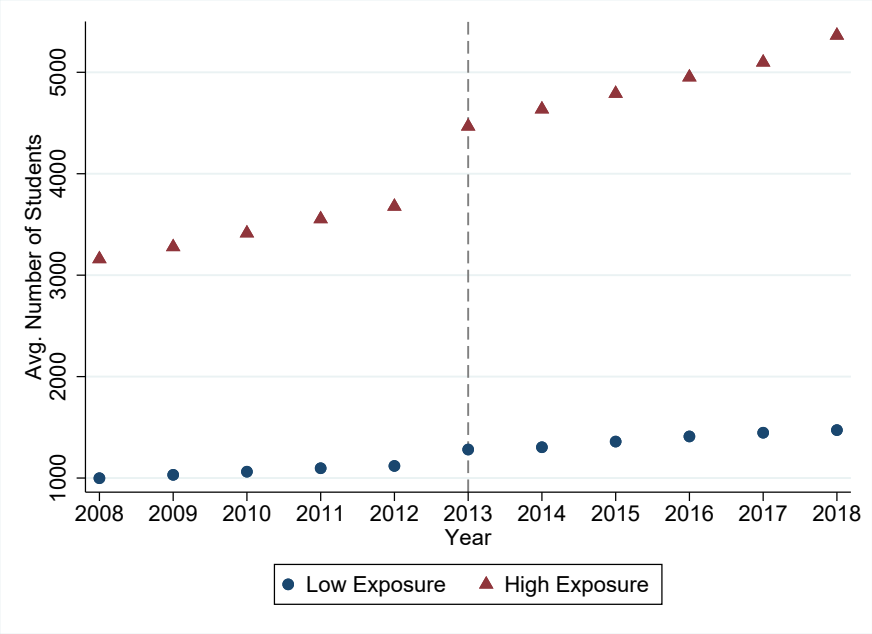


(b) Students



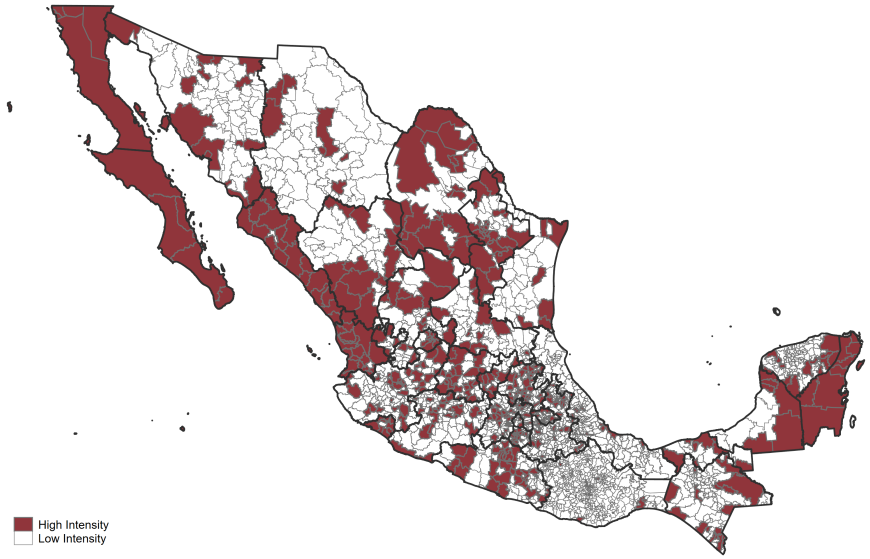
Notes: The vertical line indicates the beginning of the first academic year affected by the education reform (2013/14). Source: Information on the number of schools and students' enrollment from Estadistica 911.

Figure 2: Municipalities' average number of students by treatment exposure



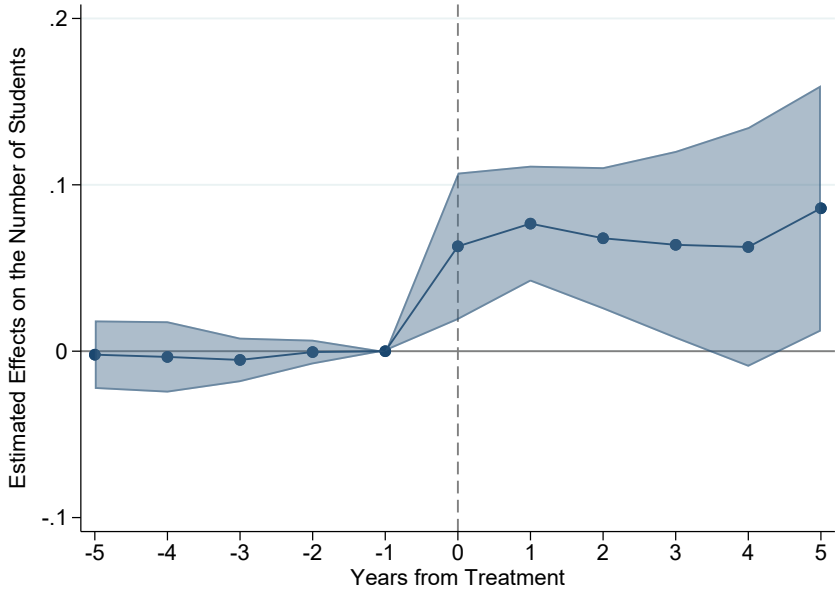
Notes: The vertical line indicates the beginning of the first academic year affected by the education reform(2013/14). See section 4.1 for the definition of high-exposure municipalities. Source: Information on students' enrollment from Estadistica 911.

Figure 3: Municipalities by intensity of treatment to the high school education reform



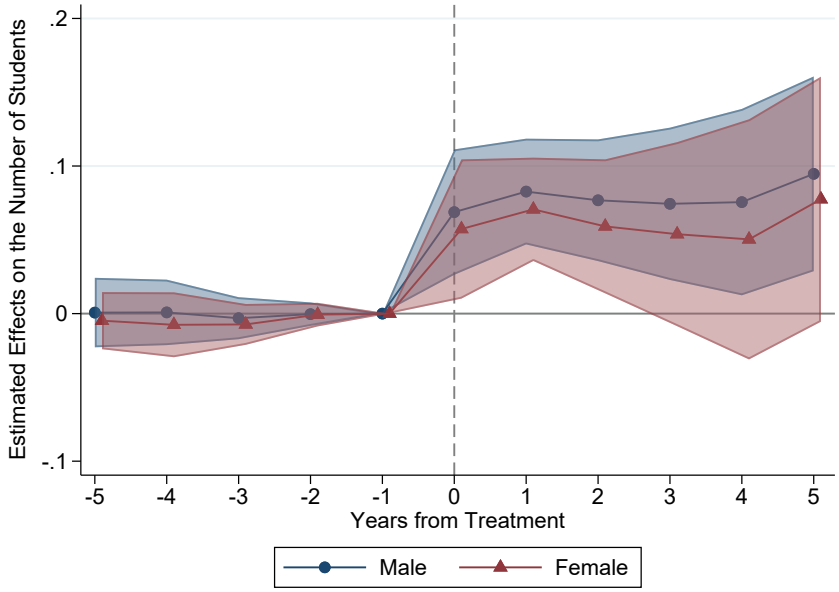
Notes: This map displays the municipalities in Mexico by their intensity of exposure to the education reform, according to the definition in section 4.1. The map contains information for 2,456 municipalities. We categorize 511 as high-exposure and the remaining 1,945 as low-exposure municipalities. Source: The definition of treatment is based on information from Estadistica 911.

Figure 4: Estimated effects of the high school education reform on the number of students



Notes: These estimates correspond to the δ_j in equation (3), using as the outcome the number of high school students in a municipality m located in region r in period t. These are Pseudo-Maximum Likelihood estimations of a Poisson model (*ppmlhdfe*). All estimates come from a single specification that includes municipality of residence and region-by-year fixed effects. Standard errors for confidence intervals are clustered at the municipality level.

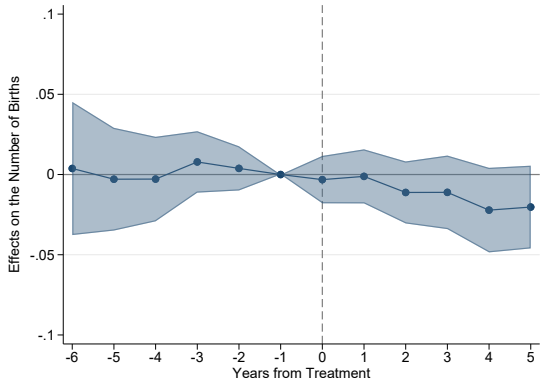
Figure 5: Estimated effects of the high school education reform on the number of students by sex



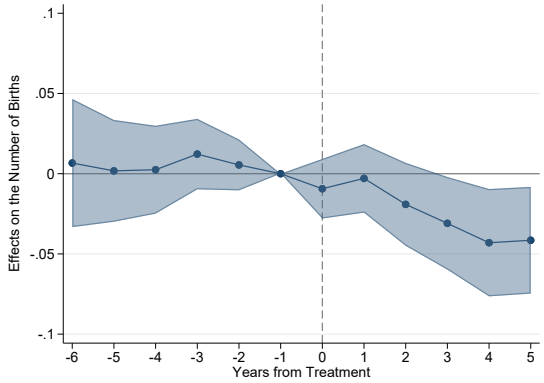
Notes: These estimates correspond to the δ_j in equation (3), using as the outcome the number of high school students by sex in a municipality m located in region r in period t. These are Pseudo-Maximum Likelihood estimations of a Poisson model (*ppmlhdfe*). All estimates for each sex come from a single specification that includes municipality of residence and region-by-year fixed effects. The blue estimates (circles) correspond to the sample of male students, and the red estimates (triangles) to the sample of female students. Standard errors for confidence intervals are clustered at the municipality level.

Figure 6: Estimated effects of the high school education reform on first births

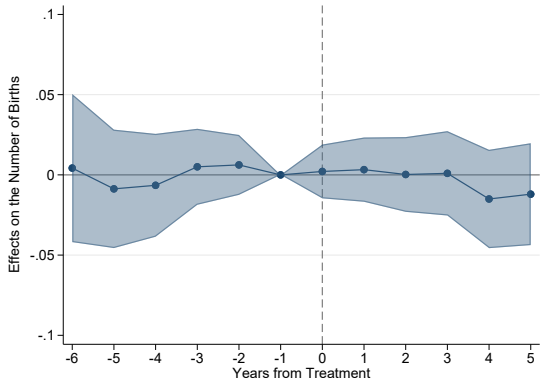
(a) All women



(b) Ages 15-19

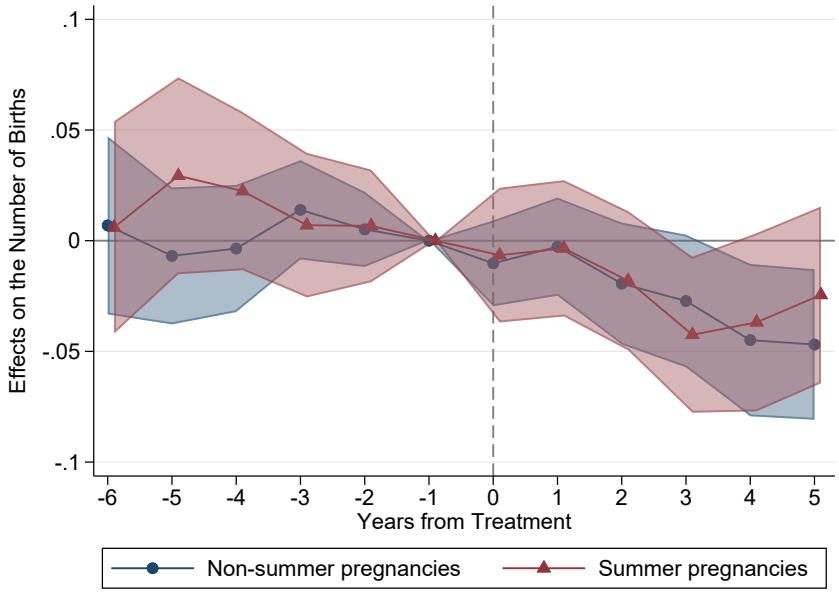


(c) Ages 20-24



Notes: The estimates correspond to δ_j in equation (3). The dependent variable is the number of first births of women in a municipality m located in region r in year t, in the age group g indicated in the subtitle. These are Pseudo-Maximum Likelihood estimations of Poisson models (*ppmlhdfe*). All estimates in each panel come from a single specification that includes municipality of residence and region-by-year fixed effects. Estimates from panel (a) additionally control for quinquennial age-group fixed effects. Standard errors for confidence intervals are clustered at the municipality level.

Figure 7: Estimated effects of the high school education reform on teen first births by approximate conception period



Notes: The estimates correspond to δ_j in equation (3). The dependent variables are the first births associated with summer and non-summer teen pregnancies. These are Pseudo-Maximum Likelihood estimations of Poisson models (*ppmlhdfe*). All estimates in each panel come from a single specification that includes municipality of residence and region-by-year fixed effects. Summer pregnancies refer to first births with an associated month of conception during the months of June to August. Non-summer pregnancies refer to births with an associated month of conception during the rest of the year. Standard errors for confidence intervals are clustered at the municipality level.

Table 1: First birth rates by females' age group

	Low exposure			**High exposure**		
	Pre-reform	Post-reform	Total	Pre-reform	Post-reform	Total
15-19	52.641	50.496	51.541	55.892	51.545	53.631
	(15.573)	(15.273)	(15.457)	(11.903)	(12.072)	(12.185)
20-24	46.052	43.791	44.892	47.459	44.163	45.744
	(13.460)	(11.778)	(12.675)	(9.546)	(8.701)	(9.263)
All women	22.541	21.139	21.822	23.483	21.443	22.421
	(5.980)	(5.142)	(5.610)	(4.338)	(4.034)	(4.304)

Notes: This table presents the average and standard deviation (in parentheses) of births per 1,000 women by the municipality of residence's exposure to the education reform, pre (2008-2013) / post (2014-2019) reform. These averages only include first births to females. The averages are weighted by the 15-49-year-old female population in the municipality. See section 4.1 for the definitions of low exposure and high exposure municipalities. The births per 1,000 women by age group were calculated using, as the denominator, the number of women in a municipality in the corresponding age group.

Table 2: Estimated effects of the high school education reform on first births

	All women	**15-19**	**20-24**
High Exposure × Post	-0.013	-0.028**	-0.003
	(0.011)	(0.012)	(0.013)
N	206304	29472	29460

Notes: These coefficients correspond to the estimate of δ_j in equation (3). The dependent variable is the number of first births for females in the age group indicated in the column. Each estimate comes from a separate regression. See section 4.1 for the definition of high exposure. *Post* is an indicator variable for the period 2014-2019. The estimates control for municipality of residence and region-by-year fixed effects. The estimates in the first column additionally control for quinquennial age-group fixed effects. The standard errors are clustered at the municipality level.
*, **, *** Significant at the 10%, 5%, and 1% levels, respectively.

Table 3: Estimated effects of the education reform on first births varying the low-exposure municipalities

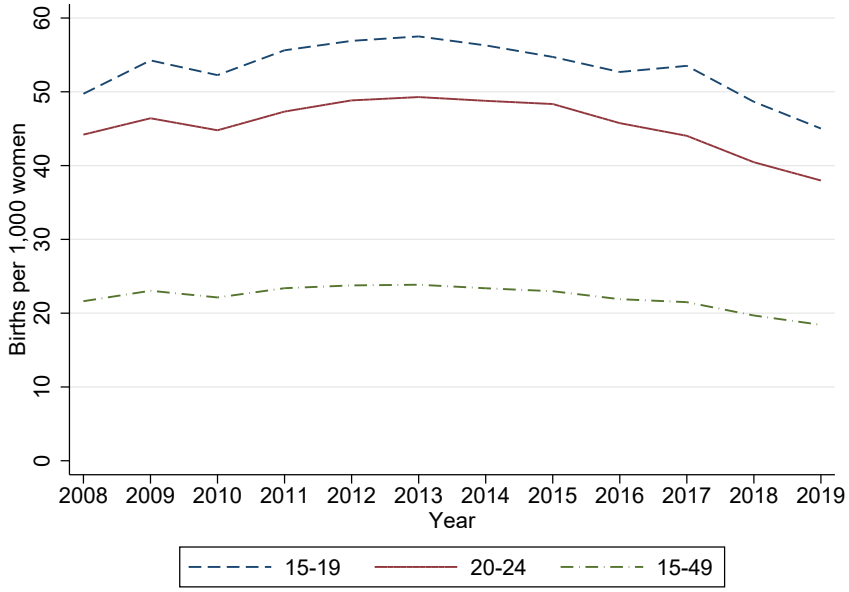
Panel (a)				
Threshold:	**x>40**	**x>45**	**x>50**	**x>55**
High Exposure × Post	-0.046***	-0.027**	-0.028**	-0.023*
	(0.012)	(0.012)	(0.012)	(0.012)
N	29472	29472	29472	29472

Panel (b)				
Excludes growths between:	**None**	**45-50 percent**	**40-50 percent**	**35-50 percent**
High Exposure × Post	-0.028**	-0.034***	-0.042***	-0.051***
	(0.012)	(0.012)	(0.013)	(0.014)
N	29472	27948	26664	25404

Notes: These coefficients correspond to the estimate of δ_j in equation (3). The dependent variable is the number of first births to 15-19-year-old women. Each estimate comes from a separate regression. See section 4.1 for the definition of high exposure. *Post* is an indicator variable for the period 2014-2019. The estimates control for municipality of residence and region-by-year fixed effects. The standard errors are clustered at the municipality level.
*, **, *** Significant at the 10%, 5%, and 1% levels, respectively.

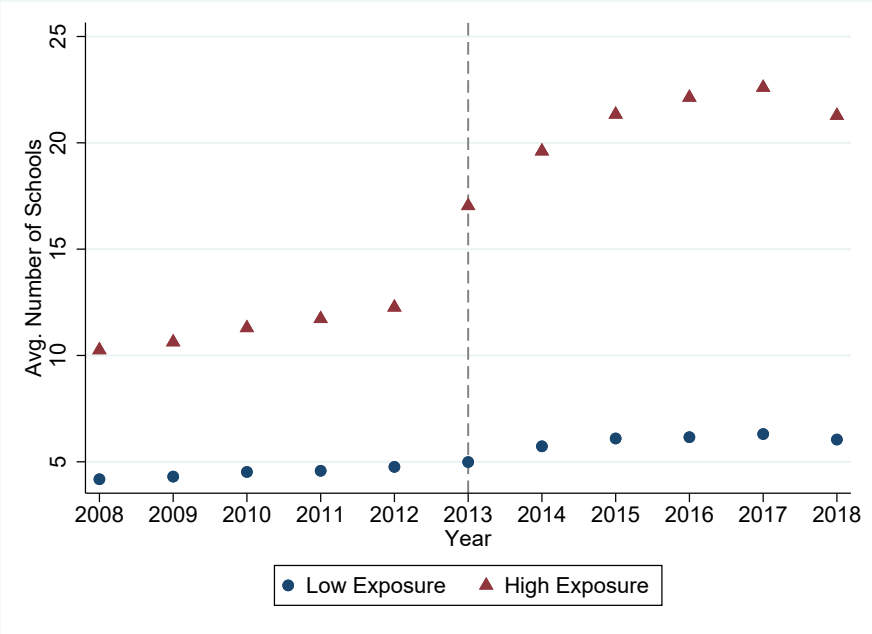
Appendix A: Supplemental Figures

Figure A.1: First births per 1,000 women by age group



Notes: This figure shows the number of first births per 1,000 women for women aged 15-19, 20-24, and 15-49 (women of reproductive age) at the time of delivery. Source: Own elaboration using information from the Birth Information Subsystem (SINAC).

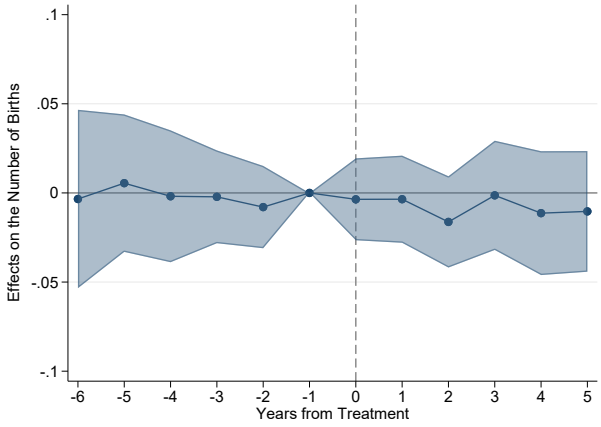
Figure A.2: Municipalities' average number of schools by treatment exposure



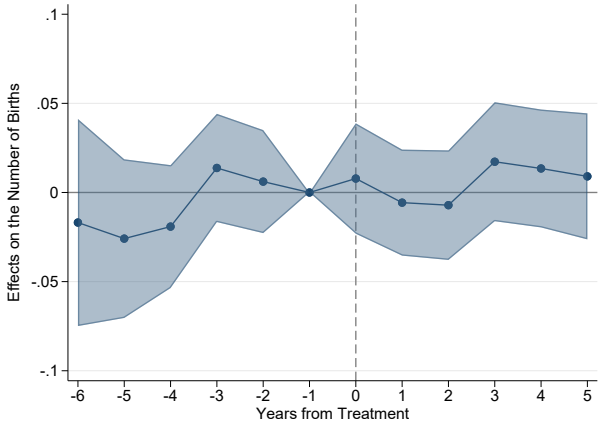
Notes: The vertical line indicates the beginning of the first academic year affected by the education reform(2013/14). See section 4.1 for the definition of high-exposure municipalities. Source: Information on students' enrollment from Estadistica 911.

Figure A.3: Estimated effects of the high school education reform on first births

(a) Ages 25-29



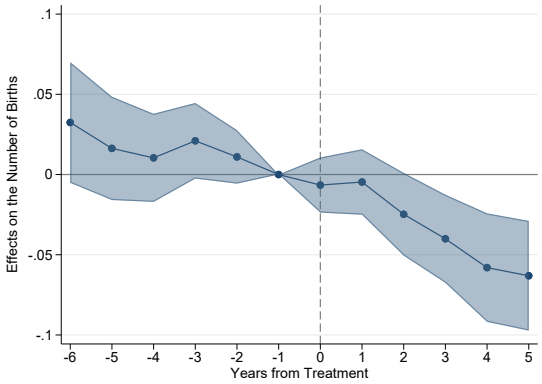
(b) Ages 30-49



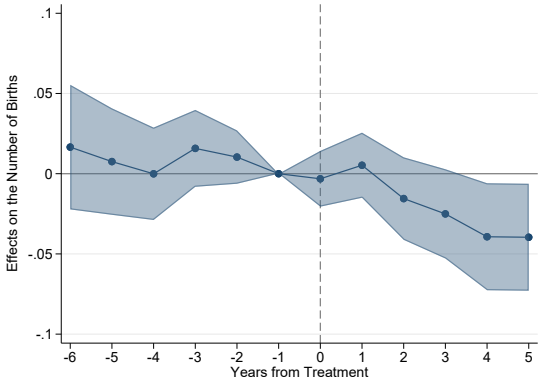
Notes: The estimates correspond to δ_j in equation 3. The dependent variable is the number of first births of women in a municipality m located in region r in year t, in the age group g indicated in the subtitle. These are Pseudo-Maximum Likelihood estimations of Poisson models (*ppmlhdfe*). All estimates in each panel come from a single specification that includes municipality of residence and region-by-year fixed effects. The estimates in panel (b) additionally control for quinquennial age-group fixed effects. Standard errors for confidence intervals are clustered at the municipality level.

Figure A.4: Estimated effects of the education reform on first births using different treatment thresholds

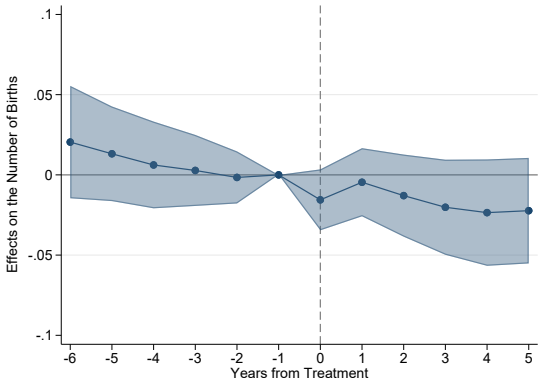
(a) $x > 40$



(b) $x > 45$



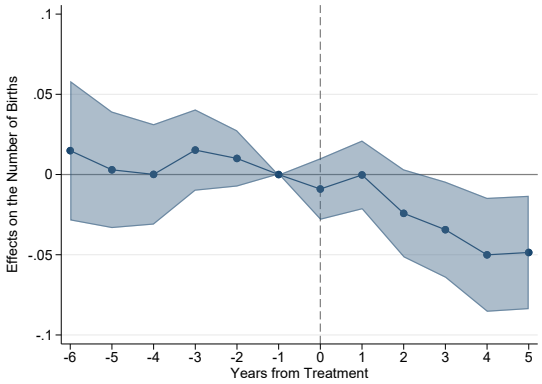
(c) $x > 55$



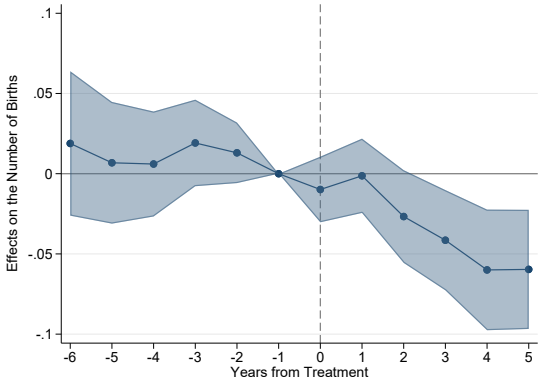
Notes: These estimates correspond to the δ_j in equation 3. The dependent variable is the number of first births of 15-19-year-old women in a municipality m located in region r in year t. These are Pseudo-Maximum Likelihood estimations of a Poisson model (*ppmlhdfe*). All estimates in each panel come from a single specification that includes municipality of residence and region-by-year fixed effects. High-exposure municipalities include municipalities where the relative growth in the number of schools pre-post reform and the relative increase in the number of schools between 2012 and 2013 are above the percentile x indicated in each panel. Standard errors for confidence intervals are clustered at the municipality level.

Figure A.5: Estimated effects of the education reform on first births varying the low-exposure municipalities

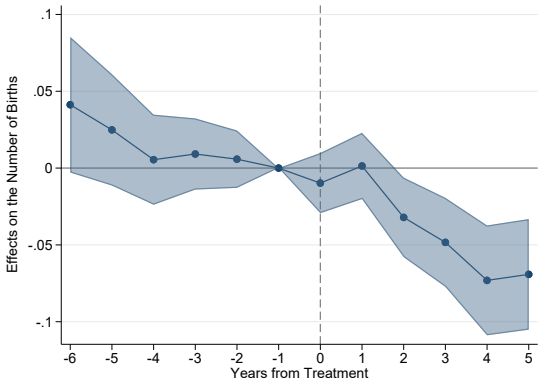
(a) Excludes growths between 45-50 percent



(b) Excludes growths between 40-50 percent



(c) Excludes growths between 35-50 percent



Notes: The estimates correspond to δ_j in equation 3. The dependent variable is the number of first births of 15-19-year-old women in a municipality m located in region r in year t. We exclude from the control group municipalities whose growth in the number of schools pre-post reform and between 2012-2013 was between the interval indicated in the title. These are Pseudo-Maximum Likelihood estimations of Poisson models (*ppmlhdfe*). All estimates in each panel come from a single specification that includes municipality of residence and region-by-year fixed effects. Standard errors for confidence intervals are clustered at the municipality level.

Table B.1: Estimated effects of the education reform on births by birth order

	All women	**15-19**	**20-24**
First Births			
High Exposure × Post	-0.013	-0.028**	-0.003
	(0.011)	(0.012)	(0.013)
N	206304	29472	29460
Non-First Births			
High Exposure × Post	-0.004	-0.018	-0.009
	(0.009)	(0.015)	(0.011)
N	206304	29280	29460

Notes: These coefficients correspond to the estimate of δ_j in equation (3). The dependent variable is the number of first births for females in the age group indicated in the column. Each estimate comes from a separate regression. See section 4.1 for the definition of high exposure. *Post* is an indicator variable for the period 2014-2019. The estimates control for municipality of residence and region-by-year fixed effects. The estimates in column 1 additionally control for quinquennial age-group fixed effects. The standard errors are clustered at the municipality level.
*, **, *** Significant at the 10%, 5%, and 1% levels, respectively.