The demographic transition and teenagers' education in Mexico

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From a theoretical point of view, competition for the educational resources at the family and the population levels changes as the demographic transition advances. Given that the reduction in the size of the cohorts that compete for educational resources has recently occurred in Mexico, it is essential to investigate how the changes in population age structure interact with the family situation of Mexican adolescents. This study assesses if the school enrollment of 13-17 year olds is associated with their number of siblings, as well as with their cohort size. The data mainly come from the 10% sample of Mexican Census. The results indicated that contextual factors explained the initial negative association between school enrollment and cohort size. However, there was a large and negative association between school enrollment and number of siblings, which was greater in the municipalities with advanced demographic transitions, once covariates were taken into account.

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1. Introduction

During the 20th Century, Mexico experienced a set of socioeconomic processes related to the education of its youth, among which are the demographic transition and the expansion of basic education. On the one hand, Mexico had a very fast demographic transition. Mortality rates started to fall in the 1930s, and after four decades of accelerated population growth, the Total Fertility Rate (TFR) dropped from 7.3 children per woman in the mid-1960s to 2.4 children per woman in 2000 (2001). Despite the decline in family size since the mid-1960s, the size of the school-age population did not diminish until recently, having possible implications on the distribution of the public resources destined to children's education. On the other hand, school enrollment grew faster than the school-age population since the late 1950s, due to the government's effort to expand educational services. Between 1950 and 1970, school enrollment of the 6-14 year-old population increased from 3 to 10 million, while the school-age population only doubled. Since the 1970s, increases in school enrollment have been moderate (Ornelas, 1998), but this expansion has been important for the national goal of reaching universal basic education.

The general purpose of this paper is to study the consequences of this demographic transition on the education of teenagers in Mexico at the family and population levels.[1] In particular, this study evaluates if the school enrollment of 13-17 year olds is associated with their family size, as well as with their cohort size in the municipality of residence in 2000. We hypothesize that the teenagers who live in places with delayed demographic

[1] Given that mortality levels since the 1980s were already quite low in most of the country (Gómez de León Cruces & Partida Bush, 2001), and that declines in mortality have a minor effect on the size and composition of the population that attends secondary schools, the influences of the demographic change on the size of current school-age cohorts can be mostly attributed to the fertility transition. Nevertheless, it is important to recognize that the momentum of growth that the school-age population is still experiencing in some areas of the country is certainly the result of the increase in population survivorship in the last five decades.

transitions (with larger cohort sizes) and who are part of larger families may be doubly disadvantaged by the competition for the available resources for education at the macro and micro levels.

The consequences of the compositional changes of the Mexican population on socio-economic phenomena have barely been studied (Alba, Banegas, Giorguli, & De Oliveira, 2006; Hanson & McIntosh, 2009; Vela Peón, 2007), and those studies that focus on educational outcomes are even more scarce (Giorguli Saucedo, Vargas-Valle, Salinas Ulloa, Hubert, & Potter, 2008). These possible macro-level influences have been largely ignored, even though the association between the demographic transition and children's education at the family level has been the focus of several studies (Mier y Terán & Rabell, 2005; Mier y Terán Rocha & Rabell Romero, 2001). This is surprising, given the popularity of the concept of the demographic dividend (Bloom, Canning, & Sevilla, 2002)[2] in political discourse during the last two presidential periods (Alba, 2008; Alba, et al., 2006).

Population projections indicate that, between 2000 and 2030, Mexico faces an opportunity for economic growth as population dependency is at a historic minimum (Mojarro & Tuirán, 2001). Within the context of education, the reductions in the size of school-age cohorts have been interpreted as an opportunity to expand the coverage of basic education and to improve schooling quality. However, a strategic plan to take advantage of those changes in age structure has not been articulated. In addition, it is empirically unclear if the demographic transition is somehow associated with the education of children. At the national level, the cohort size of children aged 9-11, those finishing the primary educational level, started to diminish in 2003 (Lam & Marteleto, 2008), while the cohort size of children enrolled in lower secondary education was expected to fall beginning in 2005 (Partida Bush, 2001).

[2] According to this concept (Bloom, Canning, & Sevilla, 2002), a country experiences a chance of economic growth during the period in which population dependency is low, that is, when children's cohorts have decreased and the size of old population is not as large as to imply an economic burden to the economically active population. However, economic growth may occur if policies are designed to take advantage of the demographic dividend, such as those to improve human capital formation and productivity.

Due to anachronic demographic transitions in terms of geography, the decline of secondary-age cohorts has not yet been occurred in some areas of the country. Therefore, there is enormous variation in child population dependency across states and municipalities. This variation makes it possible to study the association between demographic indicators and teenage education from a cross-sectional perspective. Using this methodological approach, recent findings at the municipal level for the year 2000 reveal that child dependency is negatively correlated with teenage educational outcomes such as school enrollment and lower-secondary attainment (Giorguli Saucedo, et al., 2008). However, the magnitude and significance of those estimates may be biased because the variance of educational outcomes among individuals is not considered, and individual and household characteristics are not taken into account. It remains unknown if the fertility decline in México is associated with the individual educational outcomes of teenagers by modifying the size of the school-age population, and how the size of this population interacts with the family resources destined to teenagers' education, in particular with their family size.

This study focuses on the education of the population between the ages of 13 and 17, which is the normative age range for attending secondary school.[3] Although problems of efficiency, equity, and quality of primary schooling continue unresolved (Fernández & Blanco, 2004), universal primary education attendance has basically been reached since the late 1980s (Schmelkes, 1998). In contrast, lower secondary education has been part of Mexican basic compulsory education since 1993, and attaining universal coverage here is one of the major challenges facing the Mexican educational system. In 2004, only 78% of 13-15 year olds were enrolled in lower secondary schools. On the other hand, upper secondary education was not unified until the late 1970's and is not part of basic education. Thus, school enrollment at this educational level is pretty low. Only 42% of the 16 year-old population was enrolled in the this school level (SEP & INEE, 2006). Moreover, the enrollment gaps between states and social groups have persisted, in spite of a variety of compensatory programs created during the 1990s to reduce educational

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[3] This study excludes the 18 year-old population. At this age, Mexican teenagers are more likely to leave the parental household, and therefore, exhibit more missing cases regarding their number of siblings.

inequality at these educational levels (Martínez Rizo, 2002; Mier y Terán Rocha & Rabell Romero, 2003).

The next section includes a description of the mechanisms through which the fertility decline may affect education. A summary of empirical evidence found for the Mexican context regarding the effects of family size and cohort size is presented in the third section. A fourth section includes a description of the data sets and methods. Finally, the results of the statistical analysis and some final remarks are included in the last two sections of this paper.

2. Cohort size and family size as determinants of educational outcomes

From a theoretical perspective, one of the mechanisms through which fertility can affect education at the population level is by modifying the size of the school-age population. As the cohort size increases, the public educational resources per student may diminish, or vice versa: people may experience greater educational opportunities when the population pressure goes down.

As Lam and Marteleto (2008) have noticed, the resources available to children may vary according to the competition that they face during the demographic transition. Competition is experienced at both the family and population levels when mortality rates start to decline but fertility is still high, since family size increases and the total number of children in the population increases as well. However, in the course of the transition, competition diminishes at the family level when the fertility decline offsets child survival and family size starts to fall. Children that are born in this second stage compete with a smaller number of siblings but a still growing number of children of the same age in the overall population. In a third stage, the competition at the population level goes down. The size of the childbearing-age population begins to diminish a generation after the onset of the fertility decline. After two or three decades of fertility decline, fewer births lead to a smaller childbearing population, which has fewer children, which in turn leads to smaller birth cohorts that will eventually enter school.

Accelerated population growth may adversely affect educational outcomes since countries do not usually increase their educational funds and human resources in response to changes in the size of school-age cohorts in the short run (Schultz, 1987). Population growth may affect education by reducing the educational resources per capita and, therefore, the quality of the educational services. In contrast, a shrinking school-age population may allow the allocation of the funds not used for youth educational services to either improvements in schooling quality or to educational expansion (Jones, 1975). Nevertheless, the positive association between smaller cohort sizes and children's education is theoretically ambiguous, since it depends on how educational resources are allocated and on the opportune implementation of policies that incentivize educational development. Using cross-national data from 1960-1980, Shultz (1987) showed that the population growth decreased the expenditures per child of school age, especially at the secondary level, but that school enrollment had remained unresponsive to population growth. National educational systems had been able to increase school enrollment by increasing the average class size and decreasing teachers' salaries, but the consequences for educational quality were unclear.

Cohort growth may also affect the private costs of schooling and the perceived returns to education. Lam and Marteleto (2005) have argued that children may only be admitted to a school that is farther away or at a school that has an inconvenient schedule. Parents and children may perceive that is less beneficial to attend school than to do other activities if the schools are crowded and school quality is affected. In this way, a decline in cohort size may positively affect students' performance and their motivation to attend and remain at school.

On the other hand, fertility may also affect children's education at the family level. The main hypothesis about this relationship is known as the *dilution hypothesis*. This hypothesis states that as the number of siblings increases, the family resources allocated to a particular child decrease, as well as the benefit that a child may have from using those resources (Blake, 1989; Downey, 1995; Lam & Marteleto, 2005; Steelman, Powell, Werum, & Carter, 2002). Resources are not restricted to material goods, but also include those related to parenting, such as interpersonal investment of time, communication, supervision and encouragement. Children with many siblings may be doubly disadvantaged if the available material resources need to be combined with an interpersonal investment of time from parents in order to positively affect their educational performance (Downey, 1995).

In a wide variety of settings, including developing countries, family size is negatively associated with children's education, after socioeconomic background is taken into account (DeGraff, Bilsborrow, & Herrin, 1996; Knodel & Wongsith, 1991; Lam & Marteleto, 2005; Marteleto, 2002). However, some studies have found evidence in the opposite direction: more siblings may be associated with better educational outcomes (Maralani, 2008; Mueller, 1984). Also, additional siblings may not have any independent effect on education or have a smaller influence for particular social groups (Shavit & Pierce, 1991; Steelman, et al., 2002). The conclusions drawn from these findings are that the magnitude, direction and importance of the relationship between family size and children's resources may vary, perhaps depending on the strategies that families use to survive within diverse cultural and socioeconomic contexts.

Explanations of these divergences include the influence of the culture of the family, socioeconomic development, social expenditures on education, and the current phase of the demographic transition (Lloyd, 1994). The relationship between family size and educational achievement seems to be stronger in places where education depends more on the cultural and socioeconomic resources of nuclear families. In contrast, family size may not have such an effect in places where public transfers or private support from other members of the family or society are fundamental for a child's schooling (Lam & Marteleto, 2005; Mueller, 1984; Shavit & Pierce, 1991; Si Anh, Knodel, Lam, & Friedman, 1998). Moreover, Lloyd (1994) also argues that the historical conjuncture in which socioeconomic development and demographic changes converge seems to play a crucial role on the impact of family size on schooling outcomes. The risk of mortality needs to be low in order to motivate parents to limit their fertility and to invest in their children's education. Parents need to be confident that they and their children will survive until they can benefit from their investments in education. In addition, education should be perceived as a viable way of increasing socioeconomic well-being, and for this to occur a certain level of development is necessary. Children should have access to educational services and the returns to education should be visible.

3. Empirical evidence on the relationship between education and population age structure or family size

a) Population size or age structure and school outcomes

Empirical studies on the relationship between population age structure and education are almost nonexistent in México. The discussion on the possible association between population growth and socioeconomic development in this country dates from the late 1950s. Coale and Hoover (1958) projected that México would experience faster socioeconomic growth if fertility rates declined linearly starting in 1955, and were reduced by 50% by 1970. They affirmed that an adult population with fewer dependents would be able to invest and progressively produce more, and have higher levels of consumption. Two decades later, [4] Coale (1978) argued that, in regards to education, an earlier fertility decline would have led to more rapid expansion, based on population projections and educational statistics. School enrollment rates in primary education would have been 90% instead of 64% by 1975, if the same educational resources had been used to educate a smaller school-age cohort size.

Recently, we found that child dependency has a significant statistical association with 14-18 year-old school enrollment rates at the municipal level, which decrease as child population dependency increases (Giorguli Saucedo, et al., 2008). Nevertheless, the analysis indicated that the direction of this association changed according to the level of urbanization. This relationship was negative in highly urbanized and metropolitan municipalities, but positive in rural areas, once the socioeconomic level of the municipality was taken into account. We also reported a positive association between age-grade lags and child dependency, which was consistent at all levels of urbanization. Lastly, we showed that child dependency not only affected school enrollment and age-grade gaps, but also the level of secondary attainment. A higher child dependency was

[4] At that time, the Mexican case was a puzzle for those that believed that the fertility decline would bring social and economic development, on the one hand, and also for those that supposed that economic growth would automatically produce the fall of fertility, on the other hand. The Mexican population had grown at an accelerated pace between 1955 and 1970, and population growth had been accompanied by socioeconomic growth. Moreover, population growth had not produced the expected descent in fertility rates.

associated with a lower secondary attainment in all but metropolitan places, where child dependency was lower and the levels of secondary attainment were high and less variable.

In spite of the lack of studies on the consequences of the fertility transition in México at the macro level, there are two recent studies that look at the Brazilian case that deserve attention in this section. Like México, Brazil has experienced a rapid fertility transition within a context of socioeconomic inequality. Therefore, the studies done on the association between education and cohort size may be important for comparative purposes.

Using individual data from 1977-1999, Lam and Marteleto (2005) estimated the association between the state-level growth rate of the population aged 7-14 and individual school enrollment, and the interactions between this rate and the children's sex and age, as well as the father's schooling. Their results indicated that cohort growth is negatively associated with school enrollment. Also, they found that the association was larger for older boys and for those whose fathers have less formal schooling, suggesting that this association was larger for those who are closest to dropping out of school. In addition, the authors simulated school enrollment rates from 1978 to 1999 taking as their base the 1977 enrollment rate. Their projections showed that, holding other variables constant, cohort growth was the only variable that predicted a downward trend in enrollment rates during the 1980s and an upturn during the 1990s, which in fact occurred. Although the changes in school enrollment due to cohort growth were small, enrollment rates would have increased more quickly if cohort growth had not increased during the 1980s, according to the authors.

From a cross-sectional approach, there has also been evidence in Brazil of the association between the relative cohort size of the school-age population and enrollment rates. Riani and Rios-Neto (2006) investigated this association at the primary and lower-secondary levels in 2000, controlling for the supply of education, individual and household characteristics, and spatial autocorrelation. Their findings were that relative cohort size measured for the municipality was the most important contextual factor explaining school enrollment at the primary level. Smaller relative cohort sizes were related to higher school attendance of 7-14 year olds. At the secondary level, this association was not as important, and was affected by spatial autocorrelation. The authors conclude that a reduction in the relative size of cohorts may not always yield an increase in enrollment rates at the secondary level.

b**) Family size and educational outcomes**

As in other developing countries, family size is considered one of the most important factors impeding educational progress in México (Hausmann & Szekely, 2003). Empirical findings indicate that there is a statistically significant association between family size and education in México (Binder & Woodruff, 2002; Mier y Terán & Rabell, 2005; Mier y Terán Rocha & Rabell Romero, 2001; Muñiz M., 2001; Murillo López, 2005). However, the importance of family size for educational outcomes varies through time, among diverse social groups, and within specific socioeconomic contexts.

Regarding the differences in the association between family size and education during the course of the demographic transition in Mexico, several studies indicate that the effect of family size either became significant after the fertility decline started or that the effect was significant also before the fertility decline but its magnitude increased over time. Mier y Teran and Rabell (2005) studied the determinants of dropping out from school for three generations, 1936-38, 1951-53 and 1966-68. These generations experienced growing urbanization and the expansion of primary and lower secondary education, but lived within different demographic scenarios.[5] The results indicated that family size was only related to the school dropouts of the youngest generation: having 4 or more siblings had a strong and positive effect on dropping out of school earlier. As the authors noted, the first two generations were part of larger families because the fertility decline had not yet started. Therefore, this could be the reason why the school dropouts of these generations were not affected by family size.

[5] The first generation was born at the onset of the mortality decline. The second generation had a much lower mortality than the former and a longer period of family life with both parents surviving. Finally, the youngest generation was affected by the fertility transition by having fewer siblings.

Binder and Woodruff (2002) also explored the effects of family background variables on the educational attainment of four Mexican cohorts, 1925-44, 1945-54, 1955-64 and 1965-71. However, contrary to Mier y Terán and Rabell's work (2005), the authors showed that the effect of the number of siblings was significant, even for the oldest generation. In addition, they demonstrated that there was a remarkable increase in the effect of sibship size over time, which was parallel to a decrease in the effect of parental education. The number of siblings, together with birth order, appeared to be one of the factors responsible for the stalling of intergenerational education mobility in the youngest generation.

In another study, Mier y Teran and Rabell (2001) examined the differences in the socioeconomic and demographic determinants of educational outcomes by social class. The authors analyzed the probabilities of being in the proper grade at school, being held back, or not going to school at all for a national sample of 12-14 year olds in 1995. They found that having 4 or more siblings does not affect the probability of being in the proper grade at school for the middle class, that is, for families in which the head of household is a non-manual worker. In contrast, it significantly increased the probability of being delayed at school among working-class children.[6] In addition, for the agricultural sector, the probabilities of being held back or of not going to school also were higher for children with 4 or more siblings in comparison to children in smaller families.

Some authors have also explored the association between family size and educational achievement in the rural areas of México. The results are consistent. The number of siblings seems to be inversely related to children's schooling in this context no matter what data source is used. Murillo Lopez (2005) found a negative association between the school attendance of 12-17 year olds and having more than 3 younger children in the household, in the most marginalized communities of rural Oaxaca in 2000. Mier y Terán and Rabell (2003) showed that, in rural areas of high indigenous composition, children in households with 4 or more children were less likely to complete primary education and attend secondary schools. Lastly, Muñiz (2001) showed that, in highly marginalized rural areas of México, sharing the household with small children (0-5 year olds) significantly decreased school attendance at the primary and lower-

[6] The head of household was a manual, non-agricultural worker.

secondary levels. The magnitude of the association changed depending on the children's ages: not having small siblings was more beneficial for school attendance of 11-16 year olds than for that of 6-10 year olds.

4. Methodology

a) Data sources

The individual-level data used in this analysis comes from the 10.6% population sample of the 2000 Mexican Census (INEGI, 2001). The census questionnaire records information about the school enrollment and years of schooling of children aged 5 and older. The questionnaire also includes information about the children's household structure with respect to the head of the household, and the number of children ever born (CEB) to women aged 12 and older, which makes it possible to identify the number of siblings in the maternal line under some assumptions. In addition, the 10% sample of the 2000 Mexican Census provides a set of socioeconomic and demographic variables at the individual and household levels, which can be used to estimate the net association between the selected educational outcomes and the explanatory variables.

The dataset for the analysis consists of matched individual and household records for 932,253 teenagers aged 13-17 for whom there was information on the total number of siblings. This subsample represented 83% of 13-17 year-old individuals included in the initial census sample; 3% of the missing cases are due to the lack of information on the CEB of the teenager's mothers, and the remaining 14% were not children from the head of the household and, therefore, their total number of siblings could not be determined.

At the municipal level, the 10% sample of the 2000 Mexican Census is used to generate the aggregated indicators of the population age structure, as well as other demographic and socioeconomic indicators, such as internal net migration and the educational background of the municipality. This survey contains data on 2442 of the 2443 Mexican municipalities in 2000.[7] In addition, data from the 2000 administrative

[7] One municipality in Chiapas did not participate in the census questionnaire because of the Zapatista conflict. The values for this municipality are imputed based on an average of the values of the neighboring municipalities.

registry of the Mexican Ministry of Education are included in the analysis in order to take into account the supply and quality of education in the municipalities. The Ministry of Education provided these data for most of the Mexican municipalities.[8] Finally, the municipal indexes of migratory intensity that were estimated by the Mexican Population Council are employed for the measurement of international migration (Tuirán, Fuentes, & Ávila, 2002).

b) Dependent and independent variables

The dependent variable is school enrollment, which is one if the adolescent is in school. Three explanatory variables are explored: one at the household level and two at the municipal level. The total number of siblings is used to test whether or not the demographic transition is associated with school enrollment at the family level. The total number of siblings is estimated indirectly, using the information on number of children ever born of the census. For the children of the head of the household, it is assumed that the teenager's mother is the wife of the head of the household when the head is a male or herself, when the head is a female. The number of CEB of these women minus one is considered the number of siblings of the teenagers under study. The teenager's number of siblings is classified in 6 categories: 0, 1, 2, 3, 4 and 5 and more.

The relative cohort size and the cohort size relative to the previous cohort are employed in separate analyses as proxies of the competition for resources that teenagers may face at the population level, as a consequence of the demographic transition. For the estimation of both indicators at the municipal level, the individual sampling weights are employed when aggregating.

The relative cohort size is defined as the percentage of the population under study with respect to the total population in a given municipality. The relative cohort size of the

[8] Only 7 municipalities did not have information on educational quality at the lower secondary level and 73 did not have information on the types of lower secondary schools. In these 80 municipalities, manual imputation is used. The criteria used for each educational variable is found in Giorguli Saucedo et al. (2008) .

population 13-17 is classified according to its median value (11.3) in a dummy variable, which is 1 if the cohort is above the median - a large cohort-, and is 0 otherwise.[9]

The cohort size relative to the previous cohort size is defined as the ratio between the 13-17 year-old population and the 18-22 year-old population. This is called 'cohort ratio' to distinguish it from the relative cohort size. This cohort ratio is an indicator of population growth from a cross-sectional approach. This indicator is further categorized in low and high according to the threshold of one. This threshold is a natural breakpoint, since it shows when the ratio is in balance. A cohort ratio smaller than one in a given municipality indicates that the previous cohort was larger, that is, that the teenager population under study is shrinking. The municipalities with shrinking school-age cohorts are in advanced stages of the demographic transition, when other factors are fixed. In contrast, a cohort ratio larger than one indicates that the cohort 13-17 is larger than the previous cohort. In the municipalities with this type of ratio, the competition for educational resources among their teenage populations at the macro level is still considered high.

As control variables, this study includes a group of demographic and socioeconomic variables at the individual level. These variables are age, sex, ethnicity and migratory status. A continuous variable for age and a dummy variable for sex are used in the models. Indigenous ethnicity is defined by using the linguistic criterion instead of the self-identification as member of an ethnic group, since indigenous language presented larger numbers of response. If the teenager speaks an indigenous language, he is considered indigenous in this study. Regarding the migratory status of the teenager, it is 1 if the teenager did not live in the current municipality of residence in 1995, and is 0 otherwise. Thus, it refers to the teenagers' immigration to the municipality of residence.

At the household level, this study also takes into account urban-rural residence status, family structure, head of household's education and remittances from the US. Regarding rural-urban residence status, three categories are considered. First, a teenager's residence is rural if the teenager lives in a locality with less than 2,500 inhabitants. Second, the residence is considered 'urban' if the teenager lives in a locality between

[9] Also, the quartiles of relative cohort size and cohort ratio, as well as their continuous form, were tested as an alternative to explore the relationship between the demographic transition and the selected educational variables, but the results did not provide additional information.

2,500 and 99,999 inhabitants. Finally, the residence is 'more urban' if the teenager lives in a locality with 100,000 inhabitants or more.

The teenagers' households are also classified by their family structure. In order to take into account the possible family resources the teenager has, this variable combines two criteria: if both parents live in the household (the head of household and his/her spouse) or only one of them, and if other relatives or non-relatives live in the household with them. Thus, family structure comprises four categories. They distinguish when the teenager lives with both parents; the teenager lives with only one of the parents; the teenager lives with both parents and other relatives or non-relatives; and finally, the teenager lives with one of the parents and other relatives or non-relatives. In all cases, the teenager may or may not have co-residing siblings or not.

The head of household's educational level is one of the most important control variables in the study. This indicator is related to the accumulated socioeconomic status of the family and to the way parents participate in their children's education. It is assumed that parents with greater human capital can make greater or better investments in their children's education. Head of household's education is classified into 5 categories: no formal education; 1-5 years of schooling, which is the equivalent to have incomplete the elementary education; 6-8 years of schooling, that is, primary level complete or secondary level incomplete; 9 and more years of schooling, with at least the secondary level complete or more; and a final category is created for the cases in which the household head did not have information on years of schooling, about 5% of the sample.

Lastly, at the household level, this study includes a dummy variable indicating if the household receives remittances from the US. Remittances have been associated with an improvement in the socioeconomic conditions of the household and an increase in private spending on education.

This study also includes a set of demographic and socio-economic variables at the municipal level. These variables are international migratory intensity, internal migration, region of residence, and adult educational level.

It is essential to measure international migration, since population age structure at the local level may be associated not only with the demographic transition, but also with international movements of population. The municipal index of international migratory intensity created by CONAPO is used as a covariate (Tuirán, et al., 2002). These indexes come from factor analysis of diverse inputs: the percentage of households receiving remittances; the percentage of households with migrants in the US (1995-2000); the percentage of circular migrants; and the percentage of return migrants. International migratory intensity is classified as Low, Medium or High.[10]

Internal migration is also taken into account in the analysis. It is measured through the inter-municipal net migration of the population aged 13-17. The inter-municipal net migration is defined as the difference between the internal immigrants and emigrants. A dummy variable that indicates if the municipality has positive internal migration is included in the statistical analyses.

Region of residence is employed as a control variable to take possible geographic clusters into account. Some authors classified the Mexican states by nine regions based on the states' geographic contiguity and socioeconomic development (Unikel, Ruiz Chiapetto, & Garza Villarreal, 1976). The nine regions are reclassified according to the similarity in educational profiles.[11] The Northwest and the Central regions (the Federal District and its periphery) had a consistent advantage in terms of their educational characteristics. Therefore, these two regions are grouped in one category. In a second category, two regions that share a tradition of high international migration are grouped: the West and North-Central. For simplicity, we refer to this category as West region. A third category is dedicated to the Southern Pacific Coast region, since this is the region with the lowest indicators of development in the country. Finally, the rest of the regions are grouped in a fourth category, which is called "Other." Although some municipalities of the North, Northeast, and Gulf of México regions, including the Yucatan Peninsula, also exhibited advantages in their educational factors, their landscape was more heterogeneous than the Northwest and Central regions.

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10 The ranges of migratory intensity are: null (-0.87955), very low (-0.87874,-0.58777), low (-0.58777, -0.00585), medium (-0.00585, 0.72156), high (0.72156, 1.88542) and very high (1.88542, 6.39536). The ranges are further classified in 3 categories: null, very low and low as 'Low'; medium remained as 'Medium'; and high and very high as 'High'.

11 The odds of the educational outcomes by specific regions were used to reclassify the regions.

The adult education level in a given municipality is considered a proxy of the educational history of that place. It qualitatively represents not only the socioeconomic background of the municipality, but also the human capital of the preceding generation. Therefore, it may be associated with past fertility intentions at an aggregate level and be an important control variable in the association between the demographic transition at the macro level and individual educational outcomes. The adult education level is defined as the percentage of people aged 30-50 who have completed at least the lower-secondary educational level.

The educational supply and quality in the municipality are also considered in this analysis. At the lower-secondary level, two variables of educational quality are included: the proportion of students enrolled in tele-secondary schools[12] and the proportion of qualified teachers. It is assumed that the more students take classes in tele-secondary schools, the lower the quality of the educational supply at the lower-secondary level is in a given municipality. In addition, the proportion of qualified lower-secondary teachers is also used as a proxy of the educational quality of the municipality. This is defined as the proportion of teachers who obtained their degrees from a Normal school or a University, or who continued with graduate studies.

At the upper-secondary level, the type of educational supply that was offered in 2000 is measured with a categorical variable that includes: lack of supply at this level; the presence of technical schools, either technical professional schools or *bachilleratos tecnológicos*; and the existence of general upper-secondary schools or of general upper-secondary schools and technical schools in the same municipality- what is called 'mixed supply'. It is important to distinguish the municipalities with only technical schools, because the certificate that is provided by some technical schools does not allow students to enroll in college.[13]

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[12] These institutions are lower-secondary schools, where students have access to classes via satellite systems. The expansion of lower-secondary education has depended, in great part, on the construction of tele-secondary schools since the 1990s. They are intended to cover the educational demands of remote areas that lack specialized teaching personnel.

[13] Technical professional schools: Upper-secondary schools that give a technician degree without the possibility of continuing college education. Although, after 1998, some of these schools allowed students to take additional courses in order to access higher education. *Bachillerato tecnológico*: upper-secondary schools that give a technician degree but also allow students to pursue a higher degree.

c) Multivariate statistical analysis

The multivariate statistical analysis is based on logistic regression models. The log of the odds of school enrollment is modeled as a function of the number of siblings, relative cohort size and cohort ratio, as well as the socioeconomic covariates. We apply antilogs to both sides of the logistic regression equation and interpret the exponential (exp) of the coefficient β as an effect on the odds of school enrollment in a given category with respect to the reference category. This means that for categorical variables what is expressed in the exp β is the odds ratio between categories. The exp β for continuous variables is interpreted as the factor of change in the odds of a given educational outcome for a unit change in the independent variable, holding all other variables constant (Long & Freese, 2001).

The logistic regression models were run using Stata 9 statistical software (Statacorp, 2005). All logistic regression models estimated include the 'cluster' option that Stata provides, which assumes that the observations are dependent within municipalities, but independent across municipalities. The variance-covariance matrix is adjusted for intra-municipal correlation. Robust standard errors are produced by default. Stata employs the Huber/White/sandwich estimator of variance instead of the traditional variance calculation.

This study uses five model specifications. Ten models are run; five using relative cohort size as an indicator of the demographic transition at the macro level, and five using the cohort ratio. The first model assesses school enrollment differentials by the number of siblings and the relative cohort size or the cohort ratio, controlling for age and sex. The second model adds the socioeconomic covariates at the individual and household level that were defined in the previous section. The third model incorporates the selected demographic, socioeconomic, and educational variables at the municipal level, with the exception of the municipal education level of adults. The fourth model includes the significant variables of the third model plus the adult education level in the municipality. This variable is introduced separately from the other municipal-level variables, because it is expected to account for a great part of the statistical association between school enrollment and the aggregated indicators of the demographic transition.

Finally, the fifth model tests the interaction between the number of siblings and the relative cohort size or the number of siblings and the cohort ratio in the municipality.

Likelihood ratio tests were performed before the addition of each independent variable or interaction. The tests showed that there were improvements in model fit after the addition of each variable (not shown, but available upon request). Logistic regression models without robust standard errors were used to perform these tests, because Stata only produces pseudo-likelihoods when running models with robust standard errors. In practice, however, likelihoods and pseudo-likelihoods are comparable.

Finally, with respect to the use of sampling weights, a series of means and proportions presented in the descriptive analysis section of this study are weighted by the sampling probability of each individual, which is provided in the census sample. However, the multivariate analyses were carried out using unweighted data. The 10% sample of the census survey has a one-stage cluster sampling design, in which complete geographic rural or urban areas were selected to respond to the "long form" questionnaire. Sampling weights in the 10% sample of the census survey were designed to fundamentally correct the sampling bias related to rural residence status, and rural-urban residence status is taken into account in the regression analyses.[14]

5. Statistical analysis

a) Descriptive statistics

According to the Mexican Census, the school enrollment rate for the population aged 13-17 was 70% in 2000 (**Table 1**). This population had on average about 4.3 siblings; half of the population was male; 5% migrated in the period 1995-1999; 6% spoke an indigenous language; about a quarter lived in rural areas and half resided in highly urbanized areas (with 100,000 inhabitants or more); 30% lived in a household in which the head completed secondary education or a higher level of education; 69% lived

[14] A comparison between weighted and non-weighted ordinal least squares showed that it is preferable to use un-weighted sampling data in regression analysis when the weights are a function of the independent variables introduced in the models (Winship & Radbill, 1994). The use of un-weighted data in these cases also generates unbiased and consistent estimates, but with smaller standard errors.

in nuclear families with both parents; and 5% lived in households that received remittances from the US.

TABLE 1 Socioeconomic, family and municipal characteristics of the population aged 13-17. México, 2000

Dependent variable		
Enrollment		0.70
Individual and household independent variables		
Number of siblings		4.25
	0	0.02
	1	0.11
	2	0.21
	3	0.18
	4	0.12
	5 or more	0.37
Age		14.92
Sex		
	Male	0.51
	Female	0.49
Internal migrant 1995-2000		
	No	0.95
	Yes	0.05
Indigenous language		
	No	0.94
	Yes	0.06
Residence rural-urban		
	Rural	0.28
	Urban	0.29
	More urban	0.43
Head of household's years of schooling		
	0	0.11
	1-5	0.29
	6-8	0.25
	9 or more	0.30
	Unknown	0.05
Household receives remittances from the US		
	No	0.95
	Yes	0.05

Continuation of Table 1	
Household structure	
Nuclear biparental	0.69
Monoparental	0.10
Extended biparental	0.17
Extended monoparental	0.04
Parents not identified	- - -
Municipal independent variables	
Relative cohort size	10.97
Small	0.61
Large	0.39
Cohort ratio	
Small	0.30
Large	0.70
International migratory intensity	
Low	0.77
Medium	0.13
High	0.10
Internal migratory attraction	
No	0.53
Yes	0.47
Region	
Northwest-Center	0.39
West	0.25
Southern Pacific Coast	0.12
Other	0.25
Upper-secondary schools	
Mixed supply	0.92
No schools	0.04
Only technical schools	0.04
Students in tele-secondary schools	0.34
Qualified lower-sec. teachers	0.83
% adults with lower-sec. or more	42.90
n	932,253
Weighted n	8,693,580

Source: Mexican Census Survey, 2000.

With respect to the demographic variables at the municipal level, about 40% of the teenagers lived in a municipality with a large relative cohort; only 10% lived in municipalities with high migratory intensity; 47% lived in a municipality with positive internal net migration; and 39% lived in the Northwest or Center, a quarter in the West region, 12% in the Southern Pacific Coast region, and a quarter in other regions. Regarding the distribution by cohort size relative to the previous cohort, only 30% of the population aged 13-17 belonged to cohorts that were smaller than the previous cohorts.

Table 1 also displays the distribution of the selected population by their municipal education characteristics. Even though only 2% of Mexican municipalities did not have a secondary school in 2000 (not shown), there was a high percentage of students who attended tele-secondary schools. On average, 34% of the lower-secondary students in a municipality attended this type of school, which has been an essential component of the expansion of lower-secondary education in México. Educational quality at this level of education was also poor. On average, only 84% of the teachers were qualified in the municipalities where the teenagers lived. In addition, 8% of Mexican teenagers lived in a place with limited school opportunities at the upper-secondary level, either because of lack of supply (4%) or because the schools available were only technical schools (4%), which may not allow them to continue studying in college. Lastly, on average, only 43% of the adults in these municipalities had finished their lower-secondary education.

Table 2 illustrates the differentials in school enrollment of the studied population by sibship size, relative cohort size and cohort ratio. School enrollment rates diminished as sibship size increased; with the exception of the school enrollment rate of the population with 0 siblings, which was similar to that of the population with 2 siblings. School enrollment rates for the population aged 13-17 varied, from 88% for teenagers with 1 sibling to 54% for teenagers with 5 or more siblings.

School enrollment was also lower for the teenagers who lived in places with large relative cohorts or with large cohort ratios, compared to the enrollment rates of those teenagers who resided in places with small relative cohorts or small cohort ratios. The gaps in enrollment between small and large relative cohorts and between small and large cohort ratios were very similar. The school enrollment rate of the teenagers in places with small relative cohorts was 75%, compared to a 61% of the teenagers who lived in places with large relative cohorts. On the other hand, the enrollment rate of the teenagers who belonged to a smaller cohort than their previous one was 79% versus 66% of those who belonged to a larger cohort.

TABLE 2 School enrollment by sibship size, relative cohort size and cohort ratio (means). México, 2000

Explanatory variables	Enrollment
Number of siblings	
0	0.85
1	0.88
2	0.84
3	0.75
4	0.67
5 or more	0.54
Cohort size	
Small	0.75
Large	0.61
Cohort ratio	
Small	0.79
Large	0.66
Weighted n	8,662,887

Source: Mexican Census Survey, 2000.

b) Multivariate logistic regression models

i. School enrollment and the demographic transition

Table 3 shows the odds of enrollment of the population aged 13-17 using the relative cohort size as an indicator of how advanced the demographic transition is in the places where the teenagers live. In **Model 1**, the odds of school enrollment for the teenagers with large relative cohorts were 0.71 times the odds of school enrollment of the teenagers with small relative cohorts, after controlling for number of siblings, age, and the interaction between sex and the age groups 13-15 and 16-17.[15] Regarding the number of siblings, a larger number of siblings was associated with a lower odds ratio of enrollment, with the exception of the odds ratio of enrollment of the teenagers with 0 siblings, which is similar to those of the teenagers with 2 siblings. The odds of enrollment of the teenagers with 2 siblings were 0.72 times the odds of those with one sibling, and

[15] This interaction was introduced in the model after checking why the teenagers' gender was not statistically significant. An interaction between sex and the single age of the teenagers showed that a crossover occurs at age 16 for girls in terms of enrollment. At this age, they become more likely to be enrolled than boys. Therefore, a short version of this interaction is introduced to control for that crossover.

the odds ratios of enrollment subsequently decreased with each additional sibling until reaching 0.18 for the teenagers with 5 or more siblings.

Model 2 included the individual and household variables considered in the analysis. After controlling for these variables, the advantage in school enrollment found for the teenagers with small relative cohorts, with respect to those with large relative cohorts, disappeared. In addition, although there was still a relevant negative association between sibship size and school enrollment in **Model 2**, the magnitude of this association was reduced. The odds ratios of school enrollment were more affected as the number of siblings increased.

The socioeconomic and municipal educational variables were included in **Model 3**, with the exception of the percentage of adults with at least lower-secondary education, which was added in **Model 4**. The odds ratios of enrollment by number of siblings were only slightly reduced in both models. However, the municipal-level variables substantially affected the association between relative cohort size and school enrollment. This association was reversed; from being negative in **Model 1**, it turned positive and increased from **Model 2** to **Model 3**, and then, from **Model 3** to **Model 4**. The odds of enrollment of the teenagers with large relative cohorts were 19% higher than those of the teenagers with small relative cohorts in **Model 4**. Thus, after taking the individual and the municipal socioeconomic characteristics into account, the teenagers with large relative cohorts showed an advantage in school enrollment.

Table 4 summarizes the results found in the models for school enrollment using cohort ratio (the cohort size relative to the previous cohort size). The associations between number of siblings and school enrollment were practically the same. In addition, the results for the relationship between cohort ratio and school enrollment were similar. The odds of school enrollment for the teenagers with large cohort ratios were 0.59 times the odds of school enrollment of the teenagers with small cohort ratios. This association became statistically insignificant after the addition of the individual and municipal independent variables in **Models 2** and **3**. However, it also turned positive in **Model 4**, as in the case of relative cohort size. The odds of enrollment of the teenagers living in places with large cohort ratios were 12% higher than those of teenagers living in places with small cohort ratios.

TABLE 3 Odds ratios of enrollment of the population aged 13-17 (including cohort size, n=922, 809). México, 2000

Independent variables	Model 1 OR	p>|z|	Model 2 OR	p>|z|	Model 3 OR	p>|z|	Model 4 OR	p>|z|
Number of siblings (1)								
0	0.70	***	0.80	***	0.81	***	0.81	***
2	0.72	***	0.78	***	0.79	***	0.79	***
3	0.44	***	0.57	***	0.58	***	0.59	***
4	0.30	***	0.47	***	0.48	***	0.48	***
5 or more	0.18	***	0.36	***	0.37	***	0.38	***
Large cohort size (Small)	0.71	***	1.00		1.06	*	1.19	***
Age	0.58	***	0.57	***	0.56	***	0.56	***
Male 16-17 (Male 13-15)	0.93	***	0.92	***	0.91	***	0.91	***
Female 13-15	0.89	***	0.87	***	0.87	***	0.87	***
Female 16-17	1.08	***	1.05	**	1.05	**	1.05	**
Internal migrant 1995-2000			0.71	***	0.72	***	0.71	***
Indigenous (Non indigenous)			1.19	***	1.04		1.13	***
Residence rural-urban (Rural)								
Urban			1.23	***	1.23	***	1.16	***
More urban			1.68	***	1.57	***	1.24	***
Head of household's years of schooling (0)								
1-5			1.29	***	1.30	***	1.29	***
6-8			2.05	***	2.05	***	1.99	***
9 or more			5.74	***	5.72	***	5.43	***
Unknown			1.16	***	1.16	***	1.16	***
Household structure (Nuclear biparental)								
Monoparental			0.95	***	0.94	***	0.93	***
Extended biparental			0.91	***	0.89	***	0.89	***
Extended monoparental			0.85	***	0.83	***	0.82	***
Remittances from US (No)								
Yes			1.00		1.17	***	1.17	***

***p<.001 **p<.01 *p<.05 +p<.1 Category of reference in parenthesis

Cont… Table 3	Model 1	Model 2	Model 3	Model 4
Independent variables	**OR p>|z|**	**OR p>|z|**	**OR p>|z|**	**OR p>|z|**
International migratory intensity (Low)				
Medium			0.83 ***	0.83 ***
High			0.71 ***	0.74 ***
Internal migratory attraction			0.91 ***	0.88 ***
Region (Northwest-Center)				
West			0.95	1.00
Southern Pacific Coast			0.86 ***	0.89 ***
Other			1.03	1.10 *
Upper-secondary school supply (Mixed supply)				
No schools			0.93 *	
Only technical schools			0.96	
Students in tele-secondary schools			1.00	
Qualified lower-sec. teachers			1.31 ***	1.17 **
% adults with lower-sec. or more				1.01 ***
Pseudo-Log-likelihood	-510536	-484181	-481695	-480548

***p<.001 **p<.01 *p<.05 +p<.1 Category of reference in parenthesis

Source: Mexican Census Survey, 2000.

To investigate if the association between school enrollment and number of siblings varied according to relative cohort size or cohort ratio, an interaction was added to **Model 4** in both cases. **Figure 1** shows this interaction. The numeric results are found in **Table A.1** in the Appendix. The model fit was improved by this interaction, as confirmed by the log-likelihood ratio test (not shown), which was significantly different from zero ($p<0.05$). The reference category comprises the teenagers with 1 sibling who live in a municipality with small relative cohorts or small cohort ratios; that is, those who may experience less competition for their educational resources. The categories 0 and 2 siblings were merged, since they produced similar odds ratios of enrollment in **Model 4**. Lines between odds ratios were drawn in **Figure 1** to facilitate the analysis of the odds-ratio differentials.

TABLE 4 Odds ratios of enrollment of the population aged 13-17 (including cohort ratio, n=922, 809). México, 2000

Independent variables	Model 1 OR	Model 1 p>|z|	Model 2 OR	Model 2 p>|z|	Model 3 OR	Model 3 p>|z|	Model 4 OR	Model 4 p>|z|
Number of siblings (1)								
0	0.69	***	0.80	***	0.81	***	0.81	***
2	0.73	***	0.78	***	0.79	***	0.79	***
3	0.44	***	0.58	***	0.58	***	0.59	***
4	0.31	***	0.47	***	0.48	***	0.48	***
5 or more	0.19	***	0.36	***	0.38	***	0.39	***
Large cohort ratio (Small)	0.59	***	0.92	+	1.00		1.12	**
Age	0.58	***	0.57	***	0.56	***	0.56	***
Male 16-17 (Male 13-15)	0.93	***	0.92	***	0.91	***	0.91	***
Female 13-15	0.89	***	0.87	***	0.87	***	0.87	***
Female 16-17	1.08	***	1.05	**	1.05	**	1.05	**
Internal migrant 1995-2000			0.71	***	0.72	***	0.71	***
Indigenous (Non indigenous)			1.19	***	1.05		1.14	***
Residence rural-urban (Rural)								
Urban			1.22	***	1.23	***	1.16	***
More urban			1.62	***	1.53	***	1.25	***
Head of household's years of schooling (0)								
1-5			1.29	***	1.30	***	1.29	***
6-8			2.04	***	2.04	***	1.99	***
9 or more			5.71	***	5.70	***	5.44	***
Unknown			1.16	***	1.16	***	1.16	***
Household structure (Nuclear biparental)								
Monoparental			0.94	***	0.94	***	0.93	***
Extended biparental			0.91	***	0.89	***	0.89	***
Extended monoparental			0.85	***	0.83	***	0.82	***
Remittances from US (No)								
Yes			1.01		1.17	***	1.16	***
International migratory intensity (Low)								
Medium					0.84	***	0.84	***
High					0.72	***	0.76	***
Internal migratory attraction					0.91	***	0.87	***
Region (Northwest-Center)								
West					0.95	+	0.99	
Southern Pacific Coast					0.87	***	0.89	**
Other					1.04		1.11	**

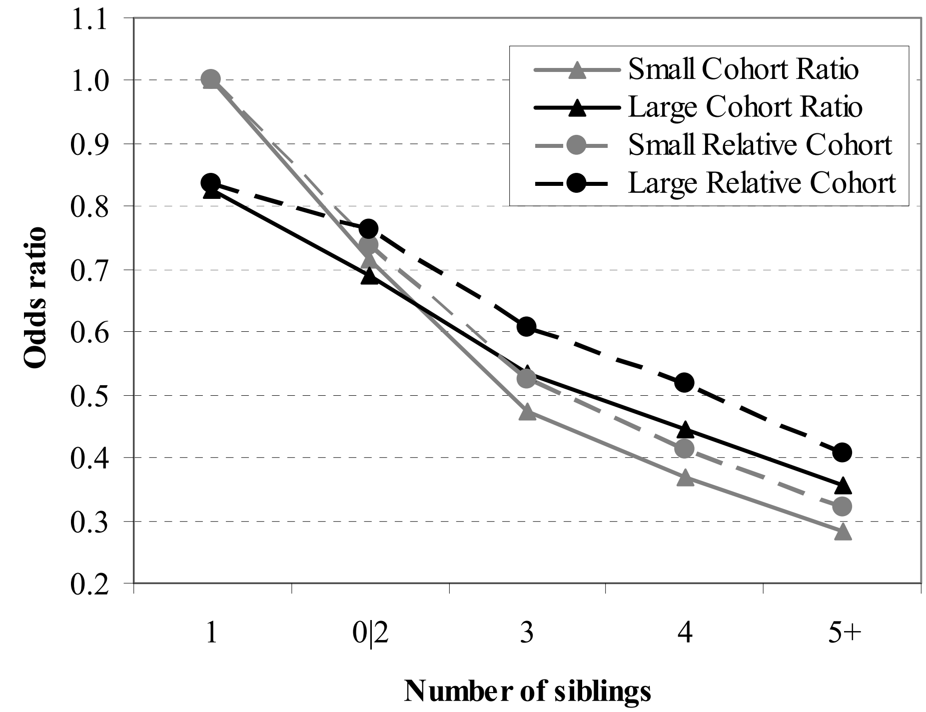
***p<.001 **p<.01 *p<.05 +p<.1 Category of reference in parenthesis

Cont… Table 4 **Independent variables**	**Model 1** **OR p>|z|**	**Model 2** **OR p>|z|**	**Model 3** **OR p>|z|**	**Model 4** **OR p>|z|**
Upper-secondary school supply (Mixed supply)				
No schools			0.93 **	
Only technical schools			0.96	
Students in tele-secondary schools			1.01	
Qualified lower-sec. teachers			1.31 ***	1.22 **
% adults with lower-sec.or more				1.01 ***
Pseudo-Log-likelihood	-509616	-484133	-481734	-480811

***p<.001 **p<.01 *p<.05 +p<.1 Category of reference in parenthesis
Source: Mexican Census Survey, 2000.

Figure 1 illustrates that the disadvantage in school enrollment for the teenagers that live in places with large cohorts only applies for 2-children families. The odds of enrollment of the teenagers with 1 sibling that reside in municipalities with large relative cohorts or large cohort ratios were about 16% lower than the reference category. Thus, the teenagers with 1 sibling may be facing greater competition for educational resources in places with large relative cohorts or large cohort ratios, compared to those that live in places where the demographic transition is more advanced. For the teenagers with 0 or 2 siblings, the differences between odds of enrollment between places with less and more advanced demographic transitions were reduced. However, for the teenagers with 3 or more siblings, the odds ratios of school enrollment were slightly larger in places with large relative cohorts or large cohort ratios. This finding indicates that children from big families exhibit lower enrollment rates in places with advanced demographic transitions than in places with delayed demographic transitions, where big families are more common. In general, the reductions in the odds ratios of enrollment by number of siblings were greater in places with more advanced demographic transitions as the number of siblings increased; which suggests a greater negative association between number of siblings and school enrollment where the demographic transition was more advanced.

FIGURE 1 Odds ratios of school enrollment of the interaction between number of siblings and the macro indicators of the demographic transition



Reference category: 1 sibling*Small cohort ratio or Small relative cohort
Source: Table A.1 in Appendix.

School enrollment and other related factors

Besides the factors linked to demographic transition, other factors associated with school enrollment that were used to control for the socioeconomic and educational conditions of the teenagers deserve attention. Only the factors that were statistically significant after the addition of other covariates are commented on (**Model 4**).

With respect to the individual demographic characteristics, the teenagers' odds of enrollment are reduced by a factor of 0.56 for each year of age, net of the effect of other factors. Although before age 16, females showed lower odds of school enrollment than males (0.87 versus 1), females aged 16-17 reported a greater odds ratio of enrollment than males aged 16-17 (1.05 versus 0.91). In addition, the teenagers that immigrated in the period 1995-1999 exhibited lower odds of enrollment than the non-migrants, which could be associated with labor migration. Lastly, speaking an indigenous language was positively related to school enrollment, net of the effect of other socioeconomic factors.

Although this finding is counterintuitive, given the poor socioeconomic conditions of indigenous people, it coincides with other authors' results on the school enrollment of indigenous people for the age group under study (Mier y Teran & Rabell, 2003; Murillo Lopez, 2004; Muñiz, 2001).

The odds of enrollment by the teenagers' household characteristics confirmed that the lower socioeconomic status of the household, the lower teenagers' school enrollment. The odds of enrollment increased as the size of the place of residence increased. Moreover, the odds of enrollment noticeably increased as the years of schooling of the household's head increased. For instance, the odds of school enrollment were 29% higher for the teenagers with a head of household with 1-5 years of schooling than those of the teenagers with a head of household with 0 years of schooling; the school enrollment advantage doubled if the head of household had 6-8 years of schooling; and it was 443% higher if the head of household completed the lower-secondary level.

Regarding the teenagers' family structure, the teenagers living with only one of the parents showed a lower odds ratio of enrollment (0.93) than those living in bi-parental nuclear families. In addition, the presence of other relatives or non-relatives at home meant a disadvantage in terms of school enrollment, which was greater for the teenagers living with one of the parents.

An interesting finding was the statistical association of remittances with school enrollment. As noted in the literature review, remittances may improve the socioeconomic conditions of the household and positively affect education; however, the absence of one of the parents or the migratory culture of the family may also operate in the opposite direction. The bivariate association between remittances from the US and school enrollment was negative (not shown). However, this association disappeared after controlling for family structure and the socioeconomic condition of the teenagers at the individual and family levels, and turned positive once the demographic and socioeconomic municipal profile was taken into account.

The municipal migration characteristics were also significantly associated with school enrollment. A higher migratory intensity was linked to lower odds of enrollment, which confirms the hypothesis of the negative effect that community migratory culture may have on education, especially if migration is seen as an alternative means of socioeconomic mobility. In addition, internal migratory attraction was also negatively associated with school enrollment, after the addition of other covariates (it was also originally positively associated). As in the case of individual internal migration, labor migration may be why positive internal net migration is linked to lower enrollment rates. Teenagers may migrate to work and, therefore, have a lower probability of continuing in school.

With respect to region, all regions had initially shown lower odds of enrollment than the reference category, the Northwest and Center regions. However, no differences were found between the West region and the reference category, net of the effect of other factors; and after controlling for the adult education level. Other regions also showed an advantage in school enrollment compared to the reference category. The only region that showed a consistent disadvantage in school enrollment compared to the reference category was the Southern Pacific Coast; which, as previously stated, has the lowest levels of development in the country.

Finally, two educational variables at the municipal level were also significantly associated with school enrollment: lower-secondary teachers' credentials and adults' lower-secondary attainment. The more teachers were qualified in a municipality, the higher the odds were of the teenagers' school enrollment. In addition, for each additional point in the percentage of adults with at least lower-secondary education, the odds of school enrollment increased 1%, holding all other variables constant.

6. Final remarks

The goal of this paper was to explore if the demographic transition in Mexico was associated with the school enrollment of Mexican teenagers by shrinking their cohorts and reducing their family size. The descriptive analysis indicated that school enrollment was negatively associated with sibship size and cohort size. In addition, the multivariate analysis corroborated that the indicators of the demographic transition at the household and population levels were associated with the schooling opportunities of Mexican teenagers.

The dilution hypothesis was confirmed. There was a large and negative association between school enrollment and number of siblings in 2000, even after controlling for the demographic and socioeconomic characteristics of the teenagers and the municipalities where they lived. Moreover, the odds of school enrollment by number of siblings showed greater reductions for each additional sibling in the places where the demographic transition was more advanced. Although our results are cross-sectional, they suggest that the relevance of family size for the teenagers' school enrollment may not go away as the demographic transition continues advancing, but that it may become more pronounced in the future as the average family size continues to decline, and big families become a smaller proportion of Mexican families. This interpretation coincides with the results of Binder and Woodruff (2002), who found an increasing impact of family size on educational attainment in México through time. Also, it agrees with the findings of a recent study of family size and educational attainment by level of urbanization in Indonesia, which shows that this association became more negative as urbanization spread in the last 30 years (Maralani, 2008).

With respect to the indicators of the shifts in the population age-structure, there was an initial large and negative association between school enrollment and cohort size or cohort ratio. However, the demographic and socioeconomic characteristics of the teenagers and the municipalities where they lived reduced the magnitude of the associations and even reversed their direction, turning them small and positive for both relative cohort size and cohort ratio. Thus, certain elasticity in the provision of educational services might have allowed numerous cohorts to have higher levels of school enrollment.

The direction of the association between school enrollment and cohort size found in Mexico differs from that found in Brazil. On the one hand, for the population aged 7-14, a negative association was found with the cohort's growth from 1977 to 1999 (Lam & Marteleto, 2008) and with its relative size in 2000 (Riani & Rios-Neto, 2006). On the other hand, the relative cohort size of the population aged 15-17 exhibited a null association with school enrollment in 2000, after taking spatial auto-correlation into account (Riani & Rios-Neto, 2006). The Brazilian analyses, however, did not take internal and international migration into account. Moreover, the level of adult education was not considered, either at the municipal or state levels, which, in the Mexican case, played an essential role in reversing the initial negative association between the macro indicators of the demographic transition and school enrollment.[16]

This paper also showed that the positive relationship between cohort size or cohort ratio and school enrollment only applied to the teenagers from 'big' families. This might be because 'big' families are much scarcer as the demographic transition advances in México. Although, as expected, the teenagers with 1 sibling showed higher school enrollment in the places with small cohorts than in the places with large cohorts, the teenagers with 3 or more siblings exhibited lower school enrollment in the places with small cohorts. Within this context, teenagers with 3 or more siblings might be facing greater competition for educational resources in the municipalities with more advanced demographic transitions.

What do the results of this paper imply in terms of education policy? The multivariate analyses show that contextual factors explain the negative association between school enrollment and a delayed demographic transition at the macro level. At this level, the course of the demographic transition may not automatically benefit teenagers' education. A reduction in the relative teenage cohorts or the shrinkage of the teenage population may not produce a general educational improvement at the secondary level. Those changes, however, may positively affect specific outcomes such as the school enrollment of those teenagers that belong to the ideal 2-child family. Thus, the opportunities for improving educational coverage as a consequence of the changes in the age-structure of the population may be limited.

At the family level, however, there is evidence of dilution of resources linked to big families, net of the effect of contextual factors. Therefore, subsequent declines in family size may benefit teenager's education. Compensatory policies that take into account family size may improve the teenagers' demand for education, especially in the places where the demographic transition is more advanced.

Further research should assess how education quality has been affected by the elasticity of the Mexican educational system. Although the rapid educational expansion may have been able to absorb the increasing enrollment demands of a growing teenage

[16] When estimating the models step by step (not shown), the migration variables and adult education played the most important role in reversing the negative association between the indicators of cohort size and school enrollment of **Model 2**.

population, education quality may still have been affected by cohort size. In addition, the possibility that the association between family size and teenagers' education may be more relevant in the future highlights the need of further analyses with causal ambitions on this topic in Mexico.

This paper provides a strong motivation for moving beyond optimistic conjectures regarding the favorable role of the shifts in population age-structure in the educational expansion of Mexico. However, the results also show a large and negative association between family size and teenagers' education, which may be stronger in the future. Thus, the paper findings demonstrate that to disregard the demographic transition in the analysis of teenage education is to miss an important part of what is affecting the costs of schooling for specific populations and their motivation for attending and remaining in school. Although national demographic indicators suggest that the demographic transition is advanced in México, this transition is one of the most important historical transformations of Mexican society; one which is still being experienced and that is currently linked to teenagers' educational resources at the family level.

Appendix

TABLE A.1 Odds ratios of school enrollment. Interactions between number of siblings and relative cohort size or cohort ratio. México, 2000

Independent variables	**Relative cohort size**		**Cohort ratio**	
	OR	**p>|z|**	**OR**	**p>|z|**
Relative cohort size*Number of siblings				
Small*0/2	0.74	***	0.72	***
Small*3	0.52	***	0.47	***
Small*4	0.41	***	0.37	***
Small*5 or more	0.33	***	0.28	***
Large*1	0.84	***	0.83	***
Large*0/2	0.76	***	0.69	***
Large*3	0.61	***	0.54	***
Large*4	0.52	***	0.45	***
Large*5 or more	0.41	***	0.36	***
Pseudo-Log-likelihood	-480359.43		-480624.72	

***p<.001 **p<.01 *p<.05 +p<.1 Category of reference in parenthe

Note: These models include all the control variables employed in Model 4.

Source: Mexican Census Survey, 2000.

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