Demographic dynamics and educational inequality in Mexico

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Abstract

The goal of this study is to analyze the relationship between education and population dynamics in Mexico. According to the theoretical tradition on population and development, the pace of population growth, family size, and migration affect human capital accumulation among the school-age population. Within the context of fast demographic change and persistent regional inequality, this study explores how three demographic dimensions affect educational outcomes at municipal level: youth dependency, teenage fertility and international and internal migration. We use data from the 10% sample of the Mexican Census 2000 and administrative records from the Ministry of Education. Different from prior research on the demography of education, this study includes three educational outcomes: enrollment, educational gaps and attainment. It also includes indicators of schooling supply and quality. The preliminary analysis shows the importance of demographic variables, their spatial dimension and the interaction with the degree of urbanization at the municipal level.

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Extended Abstract

Introduction

The study of population and development had looked at the relationship between demographic variables (especially, population growth and age structure) and socioeconomic outcomes from several analytic perspectives. In the case of education, hypotheses have been elaborated for the role that variables such as population growth, age structure (Coale and Hoover, 1958; Riani and Rios-Neto, 2006), family size (Hausman and Székely, 2003; De Graff, Bilsborrow and Herrin, 1996; Lloyd, 1994; Kelley, 1988 and 1996), and children or parents migration (Hanson and Woodruff, 2003; Meza and Pederzini, 2008; Kandel and Kao, 2001; Giorguli Saucedo, 2004) have on the accumulation of human capital.

In spite of the large expansion of education in the last fifty years, which coincides with major demographic changes in Mexico, educational outcomes are not promising when compared with other countries with similar levels of economic development in the same period (for instance, North Korea or Vietnam). Recent literature on the relationship between economic growth and the age structure suggest that, by failing to accumulate human capital at the times when the dependency ratios are low, Latin America has not taken advantage of its demographic opportunity, and therefore it has failed generating economic growth.

In the context of a rapidly changing demographic profile, new demographics trends and persistent regional inequality in Mexico, the goal of this work is to explore the link between the country's demographic dynamics and educational trends. Given the heterogeneity in educational and demographic settings that characterizes Mexico, we do not consider the country as a whole, but we focus our attention at the municipal level. We want to analyze the role that demographic dynamics have on the reproduction of the persistent educational inequality, and whether or not the fertility decline and the changing age structure that accompanies it have a positive effect on the accumulation of human capital, as other authors have argued. We approach these questions considering at the same time the possible effect of three demographic dimensions on educational outcomes: child dependency ratio, teenage fertility, and internal and international migration.

Along with the demographic variables, we look at the impact of the educational opportunities in the municipality as determinants of differences in educational outcomes

at the municipal level. This approach intends to consider to what extend differences among municipalities are explained by socioeconomic differences that determine the educational "demand" (relative size of the population in school ages, parental education, and migration to U.S., among others) and to what extent they are explained by the differences in the educational "supply", in terms of the access and quality of different educational services that each municipality provides.

Methodology

The 10% sample of the Mexican sample was used to obtain aggregated educational outcomes of the population 14-23 years old and socio-demographic indicators at the municipal level. The sample included the total of municipalities of Mexico (2442 cases), but Nicolas Ruiz, Chiapas, a municipality that rejected to respond the census questionnaire due to the Zapatista political turmoil registered during the 1990s. We used also data on educational supply and quality based on the administrative registry of the Mexican Ministry of Education for 2000. Finally, for the measurement of international migration, we employed the municipal indexes of migratory intensity estimated by the Mexican Population Council (ref). The procedures of imputation for missing data will be specified in the long version of this study.

 We use three dependent variables: the proportion of 14-18 years olds enrolled in school (enrollment); the proportion of those students that had not reached the expected educational attainment for their age (gap), that is, at least 7 years of education for those 14 years old, 8 years for those 15 years old, and so on; and the proportion of students with 9 or more years of education (lower secondary attainment). Given the high level of repetition and the long time it takes to graduate from lower secondary education in Mexico, using not only an indicator of enrollment but also of educational gap and attainment allow us to have a clearer idea of how demographics dynamics interact with educational processes.

We consider demographic and educational supply variables as independent variables. Besides the international migration index estimated by CONAPO, we include as demographic factors the children dependency ratio, adolescent fertility, internal migration, and urban composition. The children dependency ratio was defined as the ratio between the population 0-14 and that of the age group 15-64. Teenage fertility included the proportion of women 15-19 years old with children ever born. Internal migration was measured through the ratio between net inter-municipal migration of the population 14-18 or 19-23 and the population of those group ages respectively, according to the educational outcome under study. Lastly, urban composition was estimated using the proportion of population residing in rural localities in the municipality (<2,500 inhabitants). The first category comprised municipalities with 100% of rural population (rural). The second included those with between 99% and 33% (mixed rural-urban). Municipalities with less than 33% people living in rural localities and that are not part of a metropolitan area were classified in a third category (urban). The last category designated municipalities that form part of a metropolitan area according to the classification created by Garza et al (ref).

A special contribution of this study is that we incorporate variables on the educational supply as predictors of educational outcomes. We include the following variables, at the municipal level:

a) Proportion of students enrolled at *Telesecundarias*[1];

b) Teacher's educational level: proportion of teachers in lower secondary level that completed their training and/or obtained their degrees from the professional school for teachers (called Normal) or a University, or who continued to graduate studies.

c) Type of schools available: a categorical variable identifying the type of upper secondary schools that are available in a given municipality. The first category includes those municipalities that just had technical schools (either *profesionales tecnicas* or *bachilleratos tecnologicos*[2]). Those municipalities that had general upper secondary schools and/or technical schools were included as a second group (mixed supply). The third group, which is the reference category, includes those municipalities that lack any type of upper secondary school.

Because of the large tradition indicating that the transmission of cultural capital is a key determinant of educational outcomes at the individual level (ref), we decided to include a proxy of this variable, at the municipal level, as a control variable. Such a proxy is given by the proportion of adults in each municipality (30-50 years old) reaching 9 or more years of schooling. We use this measure in order to capture the extent to which educational performance depends on past levels of educational attainment, and therefore, educational development, in a given community.

After a descriptive statistical and geographical analysis of the variables under study, we explored the link between the demographic and contextual variables at the municipal level and the education indicators, using linear regression models for the country as a whole. However, OLS models assume that the effects of the variables are independent and have constant variance across municipalities. This assumption is not safe in Mexico, where the socioeconomic heterogeneity is large, and translates in spatial heterogeneity. Nearby areas are more likely to be similar to each other than to distant areas and the problem may be more severe in metropolitan zones, which imply spatial autocorrelation. Failing to take spatial autocorrelation into account, yields estimates that are inefficient and inconsistent. In order to solve this problem, we run a second set of models using GEODA 9.5. GEODA yields measures of spatial autocorrelation, from which we used Moran's I, and includes a spatial autoregressive coefficient (Lambda) into the model to control for such dependence. Finally, assuming that the effect of some variables in the models will differ depending on the urban composition of the municipality, we run a third set of models, which repeat the general OLS specification but were estimated separately according to the municipalities' urbanization level. These set of models, as well as the

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[1] These institutions are lower-secondary schools, where, instead of regular, teacher-leaded lectures, students have access to a television broadcasting educational programs and teacher's assistance.

[2] Escuelas profesional técnicas: Upper secondary schools that give a technician degree without possibility to continue studying college education. Although after 1998 in some of these schools may take additional courses in order to access to higher education. Bachillerato tecnológico: upper secondary schools that give a technician degree but allow students pursuing higher education.

first set, were estimated using STATA 10 and weighted by the census individual weight and then at municipal level by the size of the municipality.

Preliminary results

Maps 1, 2 and 3 illustrate the heterogeneous educational landscape of Mexico. Municipalities with low enrollment are geographically dispersed (Map 1), even in states located in the North and Center, where the educational outcomes at state level are the highest. Map 2 shows, however, a greater concentration of very high proportions of the population 14-18 years old with educational gap in the South compared to the North and Federal District (Map 2). Finally, also the lowest proportions of students completing lower secondary education are clustered in certain zones, for instance, those well known by their high indigenous composition, while the highest proportions are in the Northwest and in Mexico City.

Descriptive statistics (Table 1) confirm the high educational inequality by the urban composition of the municipality, besides the educational backwardness that Mexico presents. On average only 57% of the population 14-18 years old is enrolled in school, and 27% of this population has not reached the years of schooling that should have completed for its age. In addition, only 62% of the population 19-23 years old has graduated from lower secondary education. Moreover, as rural composition increases the educational situation is worse, enrollment and attainment to secondary schools are lower and educational gaps higher. Other educational and demographic indicators also seem to be related to the educational disadvantages of rural areas. Municipalities with a greater rural composition are more likely to have higher teenage fertility, child dependency and internal emigration plus lower educational supply of upper secondary schools, lower proportion of adults that completed lower secondary education, more students in *tele-secundaria* and, if the municipality is 100% rural, teachers with lower educational credentials. In contrast, 99%-33% rural municipalities have larger technical supply of upper secondary education and higher indexes of international migration on average.

Regarding the main findings of the multivariate models including the total of municipalities and controlling for spatial autocorrelation[3], we found that:

a) The child dependency ratio presents a positive statistical relationship with the educational gap, and both adolescent fertility and the child dependency ratio a negative statistical association with enrollment and attainment at lower secondary education.

b) Internal and international migration exhibits a negative relationship with the educational outcomes, except from international migration in the model of attainment to lower secondary education. The fact that educational gaps are lower as the index of international migration increases or net internal migration is more positive is striking. This may be a product of positive selectivity among those that stay behind. Those students may be less likely to be repeaters or drop out temporally.

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[3] In all models, the introduction of the auto-regressive coefficient Lambda improved their fit.

c) The urban composition of the municipality helps to diminish educational gaps as well. However, this categorical variable is not associated with educational attainment, and paradoxically, school enrollment diminishes as urban composition increases. These results are explained by the strong effect of adult's education on adolescent's educational outcomes and its correlation with urban development. In step by step models (available upon request, but not shown in the result section) is obvious that this variable competes with the urban composition at municipal level.
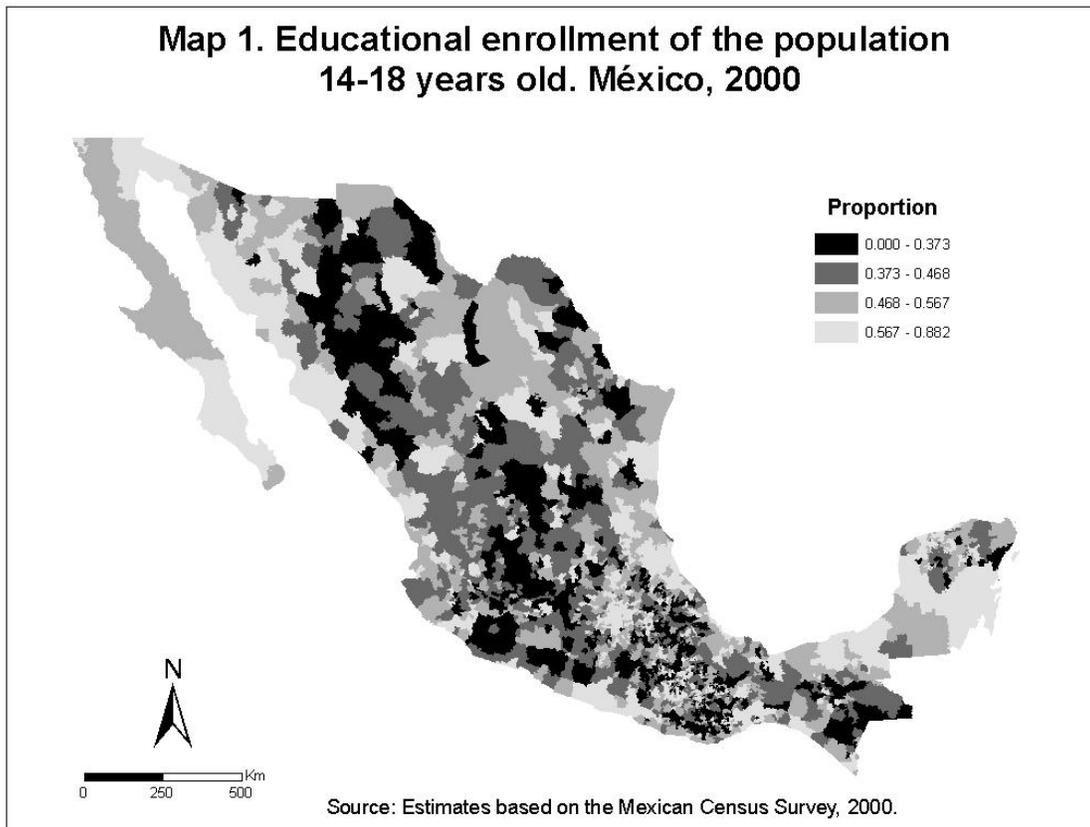
d) Regarding the variables on the type of educational supply and educational quality, the proportion of students in *tele-secundaria* only has a statistically significant relationship with the educational gap, which is negative. Teachers' education shows a direct association with enrollment to secondary education. Finally, municipalities with no school supply at upper secondary level have significantly higher educational gaps compared to those with only technical schools or mixed supply.

The results of the models by level of urbanization and a final discussion on the interpretation and policy implication of the main findings will be presented in the final version of the paper.
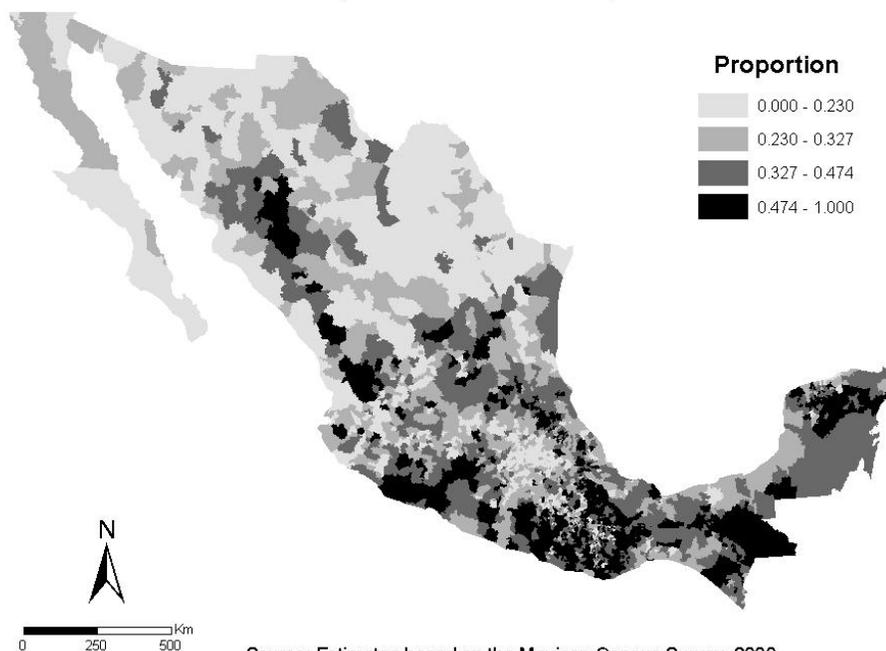
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Map 1. Educational enrollment of the population 14-18 years old. México, 2000

Proportion

- 0.000 - 0.373
- 0.373 - 0.468
- 0.468 - 0.567
- 0.567 - 0.882

N

Km
0   250   500

Source: Estimates based on the Mexican Census Survey, 2000.

Map 2. Educational gap of the students 14-18 years old. México, 2000.

Proportion
- 0.000 - 0.230
- 0.230 - 0.327
- 0.327 - 0.474
- 0.474 - 1.000

N

0 250 500 Km

Source: Estimates based on the Mexican Census Survey, 2000.

Map 3. Lower secondary school attainment of the population 19-23 years old. México, 2000

Proportion
- 0.000 - 0.294
- 0.294 - 0.446
- 0.446 - 0.593
- 0.593 - 0.947

N

0 250 500 Km

Source: Estimates based on the Mexican Census Survey, 2000.

Table 1
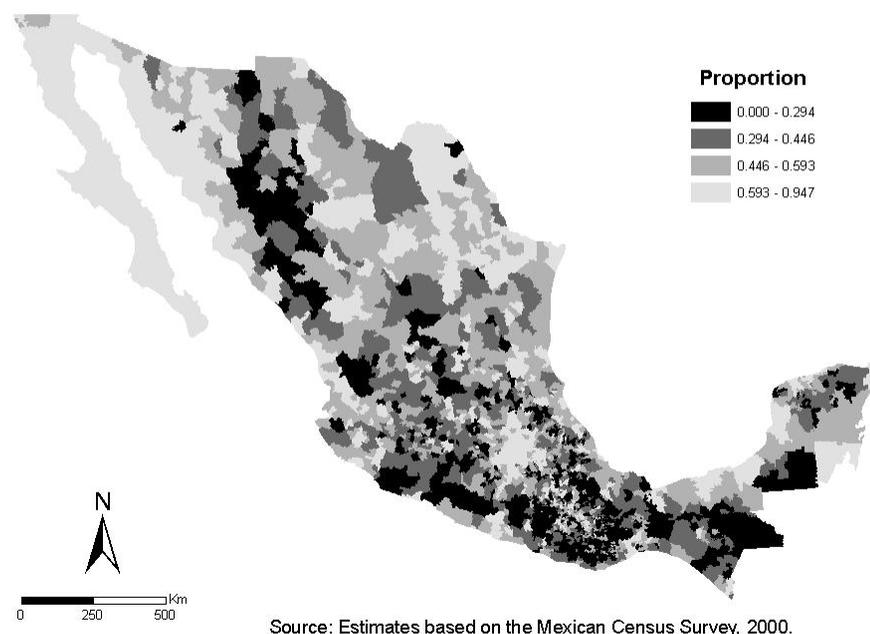**Distribution of selected variables for the study of educational unequality in Mexico, 2000**
(Means)

Variables	Urbanization level				
	Total	Rural	Mixed	Urban	MZ
Dependent					
Enrollment	0.570	0.418	0.465	0.571	0.642
Gap	0.269	0.480	0.353	0.250	0.211
Attainment	0.623	0.321	0.435	0.633	0.750
Independent					
Infant dependency ratio	0.573	0.781	0.701	0.565	0.487
Teenage fertility	0.126	0.159	0.145	0.131	0.110
International migration	-0.265	-0.039	0.070	-0.216	-0.493
Internal migration 14-18	0.001	-0.046	-0.035	0.010	0.021
Internal migration 19-23	-0.005	-0.064	-0.070	-0.002	0.034
Adults' education	0.448	0.128	0.246	0.455	0.585
Students in tele-secundaria	0.336	0.512	0.414	0.327	0.280
Teachers' education	0.836	0.769	0.843	0.848	0.834
Only technical upper secondary schools	0.037	0.059	0.068	0.056	0.009
Mixed supply of upper secondary schools	0.923	0.561	0.883	0.909	0.988
n	2443	910	836	538	159

Source: Estimates based on the Mexican Census Survey, 2000.

Table 2
Stata OLS and Geoda OLS coefficients for educational enrollment, gap and attainment. México, 2000

Independent variables	Enrollment				Gap				Attainment			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	β		β		β		β		β		β	
Infant dependency ratio	-0.061	*	-0.048	*	0.327	***	0.293	***	-0.267	***	-0.290	***
Teenage fertility	-0.334	***	-0.379	***	0.045		0.060		-0.238	***	-0.235	***
International migration	-0.043	***	-0.029	***	-0.037	***	-0.030	***	-0.010	***	0.002	
Internal migration 14-18	-0.190	***	-0.162	***	-0.109	*	-0.098	***	- - -		- - -	
Internal migration 19-23	- - -		- - -		- - -		- - -		-0.047	*	-0.033	*
Urbanization level (rural)												
Mixed urban	-0.026	***	-0.013	*	-0.057	***	-0.053	***	-0.001		0.006	
Urban	-0.054	***	-0.029	***	-0.071	***	-0.063	***	0.008		0.016	*
Metropolitan Zone	-0.077	***	-0.049	***	-0.060	***	-0.064	***	0.004		0.015	
Adults' education	0.558	***	0.555	***	-0.246	***	-0.233	***	0.717	***	0.684	*
Students in *tele-secundaria*	0.007		0.003		-0.014		-0.009	*	-0.005		-0.006	
Teachers' education	0.029		0.029	*	0.031		0.000		0.012		0.024	
Upper secondary supply (No)												
Only technical upper secondary schools	0.005		0.005		-0.053	***	-0.021	*	0.036	***	0.006	
Mixed supply of upper secondary schools	0.010		0.008		-0.037	***	-0.028	***	0.014	*	0.008	
Constant	0.405	***	0.387	***	0.250	***	0.285	***	0.455	***	0.470	***
Lambda			0.547	***			0.550	***			0.524	***
R-square	0.774		0.986		0.622		0.874		0.886		0.989	

 * p < .05 *** p < .001

Source: Estimates based on the Mexican Census Survey, 2000.