

Intergenerational Transmission of Education: Gender and Ethnicity in Guatemala

**Priscila Hermida
University of Essex
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Not much is known about the process of intergenerational transmission of educational attainment in the developing world, mainly due to the lack of longitudinal datasets. There is however reason to believe that the high degree of inequality as well as stratification prevalent in developing countries may contribute to greater persistence in the intergenerational transmission of opportunities. If schooling is strongly affected by family background, then intergenerational correlation in education across families will be high and social mobility will be low. This paper describes the intergenerational transmission of educational attainment in Guatemala through the degree of regression to the mean of the schooling of children compared to the schooling of their parents, interpreted as a measure of equality of opportunity in Guatemalan society. The approach extends the study of the process of intergenerational transmission of educational attainment in the developing world, to include ethnicity and gender as factors associated with this process. Using several specifications, the results show that educational achievement exhibits higher persistence from generation to generation among indigenous people, and for women. The work also explores the effect of high inequality in the distribution of assets between the white and indigenous ethnic groups on social mobility; and extends the analysis to investigate whether there is heterogeneity in the degree of persistence across the conditional education distribution using a Quantile Regression for counts model. Results clearly show systematic differences in the degree of persistence in educational attainment according to ethnicity with indigenous people being less mobile than whites. Overall, the analysis shows that people do not tend to regress to the mean of the population in terms of their educational attainment -a sign of relative equality of opportunity-, but it rather seems that an individual's education and chances in life are strongly correlated with those of his parents.

JEL Classification: D13, I21, J15, J62, O12;

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1. INTRODUCTION

There is vast evidence that income and education are transmitted from generation to generation¹. These intergenerational correlations have implications for the degree of equality of opportunity in a particular society and make its members more or less mobile. Schooling in particular is a mechanism of intergenerational mobility because it increases the probability of an individual's children to be educated, and thus increases their future expected income. If schooling is strongly affected by family background, then intergenerational correlation in incomes across families will be high and social mobility will be low. Intergenerational transmission of schooling affects individuals' opportunities and their well-being over time.

Not much is known about the process of intergenerational transmission of educational attainment in the developing world, mainly due to the lack of longitudinal datasets. There is however reason to believe that the high degree of inequality as well as stratification prevalent in developing countries may contribute to greater persistence in the intergenerational transmission of opportunities. This paper will focus on the intergenerational transmission of educational attainment in Guatemala and explore the effect of high inequality in the distribution of assets between the white and indigenous ethnic groups on social mobility. The degree of regression to the mean of the schooling of children compared to the schooling of their parents will be interpreted as a measure of equality of opportunity in Guatemalan society.

The paper is structured as follows: Section 1 introduces the motivation and hypotheses; Section 2 a review of the literature; Section 3 contains information about Guatemala and the education system. Section 4 includes information about the dataset and descriptive statistics; Section 5 presents the basic results on the degree of mobility in education in Guatemala; Section 6 extends the analysis to investigate whether there is heterogeneity in the degree of persistence across the conditional education distribution. Section 7 concludes.

1.1 Motivation and Hypotheses

The determinants of the parental decision on the optimal level of education of children were examined by Becker (1975). Assuming altruism and perfect capital markets, parents maximize the family wealth by investing in the human capital of each child to the point at which the marginal rate of return is

¹ For studies concerning the intergenerational transmission of income, see Behrman and Taubman (1990), Solon (1992) and Zimmerman (1992). For studies exploring the transmission of educational outcomes, see Behrman et al (2001), Borjas (1992) and Mulligan (1999).

equal to the marginal cost. Given perfect credit and information markets, the optimal level of investment in education is reached regardless of family background characteristics, including wealth or ethnicity. However, in less developed countries wealth tends to be highly correlated with ethnicity and markets do not function efficiently. Liquidity constraints become very important in this setting, since great proportions of the populations tend to be poor - lacking any form of collateral- and credit markets very underdeveloped. If one ethnic group is systematically poorer than others, different groups will exhibit different levels of investment in education, either given by differences in credit constraints (cost of education) or rates of return (due to perceived or actual discrimination in the labour market)². But not only can the average level of schooling be influenced by inequality in the distribution of assets: disadvantaged groups for which returns to education are lower and that face liquidity constraints due to poverty, may show greater **persistence** in educational attainment.

Intergenerational transmission of schooling is the result of both genetics - for instance, the transmission of intelligence or ability -, and environmental factors – like learning skills, nutritional status, and preferences for education-. How would these mechanisms work for different ethnic groups if horizontal inequalities are widespread and social exclusion related to ethnicity is present? Although it would be impossible to claim that ability and intelligence are distributed in a non random fashion conditional on ethnicity or gender, the fact that indigenous people in Guatemala are by large at the bottom of both the education and income distribution in a very unequal society, can lead us to expect differences in mobility for whites and non whites due to:

- **Direct and indirect effects of Parental Education:** there is a direct positive/negative household income effect of having more/less educated parents. Income will in turn affect the schooling of the next generation through liquidity constraints³. If higher levels of human capital are necessary to obtain higher paying jobs, poverty and inequality are transmitted from one generation to another through differences in schooling. Lower wages associated with occupations that require less education would increase inequality and transmit it to the next generation of indigenous children through the income and liquidity constraints component of the schooling decision. Moreover, parental education has additional indirect effects on social and educational mobility. Educated parents are more aware of the economic value of education, and more likely to invest in schooling. There is evidence of the fact that more educated mothers will increase the stock of human capital of the next generation by discouraging

² As noted, “...differences in opportunities, such as those resulting from discrimination and nepotism, affect demand curves.” Becker, (1975), pp. 110.

³ Additionally, less educated parents will invest less in other forms of human capital such as education at home, health and nutrition, affecting the next generation’s educational attainment.

child labour and encouraging girls to stay in school⁴. The combined direct and indirect effects of schooling in the first generation may produce non linearities in the transmission of educational attainment.

* **Effect of Assortative Matching:** education and wealth of spouses tend to be positively correlated, reinforcing the effect of human capital and other assets in the household. Thus, different levels of mobility in education could also be the effect of differences in assortative mating. This mechanism is particularly interesting in more stratified societies because it tends to make network and peer effects stronger. Network effects lower the costs of accessing school and of searching for a job, increasing the expected benefits of schooling. Social networks also increase the probability of finding a partner with similar assets. Assortative mating also has the effect of making the cultural background of the household more homogenous, and making the influence of each partner's education on persistence reinforce each other. If individuals interact more with others of the same ethnicity – and therefore tend to have similar education and income -, human capital levels will show persistence transmitting inequality through several generations. For the case of Guatemala, Quisumbing and Hallman (2003) find assortative matching at the top of the educational distribution: indigenous and rural women are less educated than their spouses, while white and urban women tend to marry men with stocks of human capital more similar to their own. As a result, differences in assortative matching and therefore in persistence in educational attainment may be expected for whites and non whites, – especially at the top of the education distribution-. Given that non-indigenous people have more education and human capital in general, assortative matching would reduce social mobility due to the intergenerational transfer of these assets through family formation, and would certainly reinforce inequality through time.

- **Effect of social exclusion on persistence:** Indigenous parents may face disincentives to investing in education in the form of lower expected rates of returns to education due to labour market discrimination, market segmentation along ethnic lines, and differences in life expectancy. All of these factors add up and curtail equality of educational opportunity for this ethnic group. In addition, cultural constraints, such as those related to the schooling of females in traditional societies, may play a role in hindering educational mobility in rural areas in particular. Unless specifically targeted for change, the institutional arrangements that enable social exclusion of one group tend to persist over time. Hence, ethnicity can affect the intergenerational persistence in educational attainment and

⁴ See Al-Samarrai and Peasgood (1998) study for Tanzania.

perpetuate inequality over time. The result may be an economy where opportunity is unevenly distributed along ethnic lines.

2. LITERATURE REVIEW

In the existing literature, two approaches can be identified to measure the effect of family background on the educational attainment of the next generation⁵. The first uses “schooling gaps” and sibling correlations to assess the effect of family characteristics (mainly parental schooling) on the educational attainment of the next generation⁶. **Dahan, and Gaviria, (2001)** use an index of sibling correlation between family background and educational outcomes is used to explore social mobility in 16 Latin American countries. This approach has the advantage that sibling correlations can be inferred from cross-sectional household survey data. Children who are performing poorly in the educational system are identified by means of an “indicator of socio economic failure”. The indicator is computed by subdividing the sample in cohorts on the basis of sex and age, and then calculating the median schooling years for each cohort. The index will have a value of one for all children up to one year behind the median number of years for their cohort. For children more than one year behind the median, the index has a value of zero. The authors proceed to calculate the correlation of scores between siblings as a way to measure intergenerational mobility. The correlation measures the proportion of the variance of schooling outcomes that can be explained by differences between families. Results show differences in mobility between countries, with social mobility increasing with mean level of schooling and income per capita. Limitations of the analysis are that school quality is not taken into account and that particularly in Latin America, schooling does not capture all possible channels through which family background affects economic success. Intuitively, factors such as family connections and parent’s wealth have a huge impact.

A second application of the “schooling gap” concept can be found in **Behrman, Birdsall , Székely (2001)**, where information on household income, father’s income, father’s schooling, mother’s schooling and schooling for children aged 10 to 21 in Latin America is used⁷. The data come from 28 household surveys from 16 countries in the region, taken between 1980 and 1996. The authors regress the schooling gap on three indicators of family background: father’s schooling, mother’s schooling and household income. The results show that increased income reduces the schooling gap, and this effect is stronger at poorer quintiles and with older children. The same is true for father’s and mother’s education. The coefficient on mother’s schooling seems to be higher in almost all sub sample

⁵ Results, data and estimation method can be found in Table 1, in the Appendix.

⁶ The schooling gap is defined as the difference between the years of schooling that a child would have been completed had she entered school at age 6 and advanced one grade each year and the child actual schooling.

estimations. It also seems to vary with income quintile, with the first quintile exhibiting the highest coefficient on mother's education.

A different approach consists of Ordinary Least Squares regression of an individual's education on parental schooling, and other family characteristics, to obtain the degree of persistence (coefficient β) in educational attainment. This is a measure of the degree of lack of mobility. In contrast, $1-\beta$ is called the degree of regression to the mean or degree of mobility in education. Table 2 summarizes results obtained using this methodology for developed and less developed countries, and a more thorough review of applications to Latin America follows:

TABLE 2 : INTERGENERATIONAL EDUCATIONAL ATTAINMENT STUDIES

STUDY	Persistence	COUNTRY
Borjas (1992)	0.25	United States
Mulligan (1997)	0.32	United States
Couch and Dunn (1997)	0.20	Alemania
Beehrman et al (2001)	0.35	United States
Beehrman et al (2001)	0.70	Brazil
Beehrman et al (2001)	0.70	Colombia
Beehrman et al (2001)	0.50	Mexico
Beehrman et al (2001)	0.50	Peru
Veloso and Guimares (2003)	0.68	Brazil

Behrman, Gaviria, and Székely, (2001) apply The OLS regression method to household surveys that include recall data on parental education for Brazil (1996), Colombia (1997), Mexico (1994) and Peru (1985); using an additional sample for the USA -General Social Survey (1990-1997)- for purposes of comparison. Parental education is defined as the education of the most educated parent in the family, that is, mostly fathers. The results show that there is more intergenerational mobility in the US and that the significant differences found between the Latin American countries studied are correlated with mean schooling attainment over time for each country. Estimates or the β 's are 0.7 for Brazil and Colombia and 0.5 for Mexico and Peru, compared with 0.35 for the US. Mobility is substantially higher for men in Mexico and Peru when compared to women. When using cohort analysis to explore the relationship between mean schooling attainment and schooling mobility, the authors find big differences in the initial level of mobility and in the rate of change of the β 's over time for Latin America and the US. While the later showed a high level of mobility that did not change much over cohorts, the former region had significant lower levels of mobility for older cohorts that increased steadily for younger cohorts.

Binder and Woodruff (2002) use data for urban Mexico in the 1994 Gender, Age, Family and Work household survey, on information on educational attainment and employment status of respondents, as well as educational attainment of the head of the family when the respondent was 14. The authors regress years of schooling of the respondent on family characteristics: number of siblings, geographical area, education of father, occupation, medical insurance cover for the household head and whether the father was present at age 14. The results show all income proxy variables are positive and significant for both men and women and across all cohorts. The effect of favourable background characteristics on years of schooling decreases from cohort 1 to 4, denoting an increase in mobility. As years of education of the father becomes less important as an explanatory variable; presence of the father, number of siblings and birth order explain a bigger proportion of educational attainment of the respondent.

Veloso and Guimarães Ferreira (2003) use a national household survey for 1996, where a recall categorical question regarding parental education is included. An OLS model is run for the entire sample, with controls for age and age squared of the child and dummies for urban areas, ethnicity and region. OLS estimates for intergenerational mobility in education show it is lower in Brazil ($\beta = 0.68$) than those obtained for more developed and also developing countries for which there is data available. Evidence of significant non-linearities in educational mobility is shown. There is lower mobility for children of parents with very little schooling when compared to children of parents with more schooling. Lower mobility is observed again the top of the distribution. The coefficient associated with parental education squared is significant and negative, suggesting that mobility increases with parental education.

3.1 GUATEMALA

According to the World Bank, the total population of Guatemala in 2000 was around 11.4 million, out of which 39.2% were indigenous and 60.8% white⁸. Approximately 56.2% of Guatemalans live in poverty; while 15.7% live in extreme poverty. In 2000, 6 out of every 10 citizens lived in rural areas, with the highest incidence of poverty concentrated in the North, and the Northwest⁹. Income inequality in the country is among the highest in the world, with a Gini coefficient is of 0.57.

The proportion of indigenous population is one of the biggest in Latin America; there are around 22 linguistically differentiated indigenous ethnicities. The largest group is the Mayan –comprising the Kiche, Qeqchi, Kaqchiquel, Mam and others-; there are also two small non-Mayan groups, the Xinca

⁸World Bank, (2003).

⁹ Alta and Baja Verapaz, Huehuetenango and Quiche Departments.

and the Garífuna. Most of the Mayan people –about one million- are of Kiche origin and live in the western highlands near the cities of Santa Cruz and Chichicastenango. There are between one million and two million Mams and Kaqchiquels, with this last group located in the northwest part of the country near the Mexican border. The Qeqchi can be found in the north eastern region of Alta Verapaz, and are estimated to be around 400,000¹⁰. Other groups include the Chorti, Achi, Ixil, Poqomam, and Tzutuil.

Guatemalan society has been historically characterized by stratification based on ethnicity. Since independence from Spain in the early 19th century, wealth has been concentrated in a small white elite. Elites used cheap indigenous labour for export-oriented crop industries -coffee, sugar, cotton, cardamom and rubber- during the 19th and 20th centuries. Forced labour in plantations and coercive recruiting systems were common. A functioning labour market did not develop until the mid 20th century. Today indigenous people mainly engage in small farm production and obtain seasonal labour earnings from migration¹¹. Guatemala has long been affected by political violence, starting in 1954 toppling of the reformist government of Jacobo Arbenz¹². Civil war started in 1960 and did not end until 35 years later. Democracy was reinstated in 1986. In 1996 Peace Agreements were signed between the Guatemalan Government and the Guatemalan National Revolutionary Unity (URNG). Throughout the 1980's, rural areas and indigenous communities were particularly affected by violence. The violence had long term economic and demographic effects¹³. As a result of the civil war, fewer families engage now in agricultural activities. Rural economies based on grain production have given way to small-scale commercial agriculture and activities in services, transport and other non-agricultural activities. During the 1990's, the indigenous population has migrated to the lowland plantations, the capital or regional market cities in order to increase their income, and has become older and more urban as a result.

Overall, indigenous people still face barriers in the education, labour and credit markets and have less opportunities for acquiring different forms of capital; mainly as a result of discrimination and other market failures¹⁴. Indigenous people are over represented amongst the poor when compared to whites, with the poverty headcount at 74% for indigenous and 38% for whites. Income inequality in Guatemala has been found to be correlated to differences in assets such as education, land, housing and geography;

¹⁰ Dictaan-Bang-oa and Medrana, 2002.

¹¹ Migration happens during harvesting time in the Coastal plantations of export-oriented crops such as coffee and cotton.

¹² Oficina de Derechos Humanos del Arzobispado de Guatemala (1998).

¹³ Estimates of the total number of deaths are above 200,000. Family structure, especially in rural areas, was affected by death or displacement. In the 1980's, a million indigenous people fled from their homelands due to military violence. See UNDP, (2000).

¹⁴ Vakis (2003).

and also to ethnicity. Differences in education explain half of the observed income inequality, while belonging to an indigenous group explains 21% of it ¹⁵.

3.2 THE EDUCATION SYSTEM

School age population in Guatemala covers children between 5 to 18 years old. According to ENCOVI¹⁶ data, there are 4.65 million Guatemalans of schooling age. The education system consists of three levels: Pre-primary (5 and 6 years of age), Primary (7 to 12 years) and Secondary (13 to 18 years of age). Secondary is divided in two components: basic (13 to 15 years) and diversified (16 to 18 years). The duration of compulsory education is 7 years, after which students may leave the education system at the end of Primary schooling, usually at age 12-13. Primary school is meant to provide a child with a fundamental understanding of math, reading, and writing. There are other less common schemes substituting Diversified Secondary, such as Technical Secondary School or Teacher training qualification, lasting 3 years. Higher education is provided by one public, and several private universities. The Academic year lasts from January to November. The language of instruction is Spanish, and there is limited bilingual education in rural areas.

The effectiveness of the educational system is constrained by a shortage of trained teachers, inadequate school buildings, and long distances from home to school for many students. Enforcement of Primary school attendance is very lax. Net primary enrolment is 85%, but a gender gap remains ¹⁷. An important characteristic of the Guatemalan education system is the problem of over-age and late enrollment ¹⁸. While the system fails to meet the target for Pre-school, Secondary and Higher Education, the Primary school level is overburdened by over-age and repetition¹⁹. Significantly, 100% coverage is not reached in any schooling level or age, which means that many children never go to school.

The distribution of education is very unequal and is correlated with the income distribution²⁰. According to the UNDP, 70% of the population reads and writes, although there are important differences between urban and rural areas, and between ethnic groups²¹. Educational attainment is considerably lower in rural communities because children tend to be employed in farming and educational facilities are not always available. Differences in schooling between sons and daughters have been found to be

¹⁵ World Bank (2003).

¹⁶ Encuesta Nacional de Condiciones de Vida (ENCOVI), a national household survey carried out for the first time in 2000.

¹⁷ UNDP, 2002.

¹⁸ 19% of all 15 year olds are still in Primary school Edwards (2002).

¹⁹ A consequence of late over-age and late enrolment is that it increases the cost of the education decision since, for any level of educational attainment, individuals enter the job market at a later time and their future income flow is reduced.

²⁰ Edwards (2002) finds that while Primary school enrolment is almost universal for the non-poor (110% gross enrolment rate), an important proportion of the poor will never go to school (93% gross rate).

²¹ UNDP (2000).

important in rural households, both indigenous and non indigenous²². Girls seem to drop out school earlier than boys, particularly after age 16²³. Children who abandon school stop acquiring a very important form of human capital, and the probability of them becoming poor in adulthood increases. They may become poor fathers and mothers of poor children, their educational attainment influencing the attainment and income of their offspring.

Indigenous people have less education than whites and leave school sooner²⁴. Indigenous families seem to be inclined to stop education after the end of Primary school²⁵. This may be the result of different incentives in their decision to initiate or continue education. The chosen level of investment in education for children belonging to an indigenous household may be affected by differences in life expectancy, differences in expected returns to education and the opportunity cost of child labour.

PART IV: DATASET AND ANALYSIS

4.1 Dataset:

The measurement of social mobility in the context of a less developed country depends on the available data. Most of the data for the region –with the exception of Brazil- consist of cross-sectional, not panel data sets. Faced with such limitations, Behrman (2001) suggests the estimation of relations from cross-sectional datasets that contain recall data²⁶.

The ENCOVI dataset was used in this paper for the analysis of educational mobility. It is the first Living Standards Measurement Survey available for Guatemala, conducted between July and November of 2000 by the Instituto Nacional de Estadística (INE), with support from the World Bank and the Inter American Development Bank. Sample design was based on the 1994 National Population Census sample, covering urban and rural areas in the country²⁷. Information from each household was collected on income, expenditure, prices, education, health, labour market participation and access to public services.

²² UNDP, *ibid*.

²³ There is a significant fall in enrolment rates for boys and girls at the end of primary education, but the decrease is more pronounced for girls. The gender difference in net enrolment at ages 7 to 9 is of 6 percentage points, decreasing to 2 points for 10 to 12 year olds, and then increasing again to 11 percentage points by the time girls turn eighteen. UNDP, *ibid*.

²⁴ In areas where the percentage of indigenous population ranges from 60 to 80%, net enrolment in Secondary school is only 10.8% of the target population, compared to 34% in areas less than 20% indigenous, UNDP (2002).

²⁵ There is a substantial drop in enrolment in Secondary education for indigenous children when compared with the percentage enrolled in Primary education; as well as when compared to enrolment of non indigenous children in Secondary education.

²⁶ A problem in using recall data is that it is noisy and hence overestimates social mobility. (Measurement error: $cov(x, e) \neq 0$). We can think about the results as an “upper bound” for social mobility in education. Another source of bias pointed out by Lillard and Willis (2004) is the possible correlation between education and mortality rates.

²⁷ The two-staged, stratified sample comprised 8, 940 households without replacement. Estimated rejection rate was 10%.

The data from ENCOVI used was education (years) of each surveyed individual and the educational attainment of her parents. The parental education variable is a categorical one and was transformed into a continuous variable for the effects of the analysis²⁸. Individuals younger than 22 years old were eliminated from the sample since there is a possibility that they are still enrolled in the education system. The final sample contains 15,662 cases for which complete information on individual and parental education is available. Although the dataset allowed the possibility to distinguish between eight different ethnic groups –including whites-, all observations corresponding to non-white individuals were grouped into a single indigenous category due to subsample size considerations²⁹. In order to explore the change in educational mobility over time, respondents were divided into four cohorts corresponding to individuals born from 1900 to 1978. A variable describing being born in a rural area or in a city was created from information on the survey. A variable describing the difference in educational attainment between the father and the mother of the individual was also created as a proxy for the degree of assortative mating.

4.2 Descriptive Statistics:

Out of the resulting sample, 47 % individuals are male and 53 % female. In terms of ethnicity, 61.4 % are white and 38.6 % describe themselves as indigenous. The sample is evenly divided into individuals born in rural (52.4%) and in urban areas (47.6%). Table 3 in the Appendix summarizes ethnicity and region of birth. The average schooling for the whole sample is 4.7 years. A third of the sample (27%) has zero years of education, and an additional 39% has not completed primary school. These figures are consistent with other sources of data for education in Guatemala³⁰. An important group of individuals (14%) only reads and writes. The percentages of people who have completed primary or secondary school are around 13% each. Only around 6% of the sample has higher education.

As shown in Figure 1, the distribution of educational attainment in Guatemala is skewed to the right with mean of 4.7 years and median of 4 years of schooling. On average, men have more education than women, and white people are more educated than the indigenous. Similarly, the dispersion in the distribution is bigger for whites than for indigenous. The descriptive statistics for the sample as a whole conceal important sub-group differences (Table 4). On average, a white man will have more than four years of education than an indigenous woman. In the same way, the median of the distribution of

²⁸ The categories for parental education in the survey are: “No Education” (0 years), “Incomplete Primary” (1-5 years), “Primary” (6 years), “Incomplete Secondary” (7-11 years), “Secondary” (12 years) and “Higher Education” (more than 12 years).

²⁹ The recorded ethnic groups were Kiche, Queqchi, Kaqchiquel, Mam, other Mayan, Garifuna, Xinca and White. Garifunas and Xincas were dropped from the sample given very small sub sample size.

³⁰ As a convention, an individual with 3 years of schooling is classified as functionally illiterate, therefore the figures are low when compared to other countries of a similar level of economic development. World Bank, GUAPA.

schooling for white men is 6 years -meaning that 50% of the members of the group will have more than a primary school education-, whereas the median for indigenous women is zero years. At least 50% of this subgroup will have no education at all.

A corresponding pattern of inequality in the distribution of human capital can be found when analyzing the education of the parents of individuals on the sample. The lack of provision of schooling in Guatemala -particularly for women and for those in rural areas- during the first half of the twentieth-century explains the low levels of parental education. Overall, fathers are more educated than mothers, and both have very few years of education. Mothers in particular are deprived of schooling. The means of the distributions of father's and mother's schooling are 2.3 and 1.6 years respectively. The median of years of education is zero for both; therefore at least half of all mothers and fathers had no schooling. Whites have more educated parents than indigenous people, with the difference being around an additional 2 years of schooling on average for fathers and mothers educational attainment.

Over time, educational attainment improves for all, but as mentioned, the process starts at very low levels of human capital stock. For the sample as a whole, educational attainment has constantly increased, with the greatest gains made by those born before 1960. The average number of years of education has gone from 2.7 years for those born before 1950, to 6 for the cohort born between 1970-79, as can be observed in Figure 3. In spite of that, uneven progress is shown when comparing gains made in education by indigenous people vs. whites. Although average schooling has increased for both ethnic groups during the past century, it has only done so by around 3 years, with the overall mean going from 3 years for the first cohort, to 6 years for the 1970-79 birth cohort. The rate of growth in average schooling has similar for non-whites than for whites, but indigenous people start at a mean of 1 year of education for the first cohort, vs almost 4 years for whites³¹. There seems to be no convergence in average schooling between white and indigenous Guatemalans. Public efforts to make the distribution of education less unequal seem to have failed: the gap in average years of education between whites and non-whites has remained constant at 3 years for more than six decades, as can be observed in Figure 3.

4.3 The Education of Parents and Children

Educational attainment has improved in the last century and as a result, Guatemalans born in later cohorts have more education than their fathers and their mothers. However, consistent with lack of social mobility, big differences in educational attainment conditional on parental education remain: the average of years of education of adult children is positively correlated with parental education and more

³¹ According to the data, it took 50 years (from 1900 to 1950) to increase average schooling of indigenous people from 0.5 to 1 whole year.

educated parents have more educated children. The correlation coefficient between father's and child's education, and mother's and child's is 0.60, when considering the entire sample³². For the indigenous group, the correlation between parental and child education is lower (0.47 for father's and 0.4 for mother's education). This is possibly a reflection of the massive improvements in educational attainment for this subgroup in the last fifty years that may have resulted in greater intergenerational mobility. Intergenerational correlation in schooling attainment is problematic because, as pointed out by Ashenfelter and Rouse, a high correlation between father's and son's education not only would signal lack of social mobility, but would also overestimate the causal effect of schooling on income, by not taking into account the effect of educated parents connections³³ and lower information costs associated with network effects. Income inequality and lack of opportunity would be reinforced through the direct mechanism of transmission of human capital and through social capital networks.

An additional point of interest is the correlation between educational attainment of spouses, since the functioning of the marriage market is connected to intergenerational mobility. Assortative mating produces a more homogenous cultural background within a household, reinforcing the effect of having more educated parents³⁴. Low rates of assortative mating increase mobility by spreading the stock of human capital more evenly across many households. Sorting by education in the marriage market is also associated with high levels of inequality, either due to spatial stratification or discrimination³⁵. In the ENCOVI sample, while the correlation in educational attainment between parents (spouses) is of 0.68 for whites, it is only of 0.49 for indigenous people, hinting at a higher degree of assortative matching in education for the white portion of the population.

Across the whole sample, the data confirm that more educated parents will have more educated sons and daughters. For example, as shown in Figure 4, the difference in the average years of schooling between the off-spring of a man with no education, compared to the child of a parent who has gone to University, is of more than 10 years. People do not tend to regress to the mean of the population in terms of their educational attainment -a sign of relative equality of opportunity-, but it rather seems that an individual's education and chances in life are strongly correlated with those of his parents.

³² The correlation estimate is higher than the 0.4 correlation coefficient between father's and son's educational attainment obtained by Ashenfelter and Zimmerman (1997) and is also higher than the 0.42 correlation in education between father and respondent reported by Hauser et al Carter (2000), in both cases for the USA.

³³ See Ashenfelter and Rouse (2000), in Arrow, Bowles and Durlauf, eds.

³⁴ Ermisch and Francesconi (2002) find evidence of intergenerational transmission of social capital through this mechanism: richer parents are more likely to have a larger stock of social and human capital to pass on to their children.

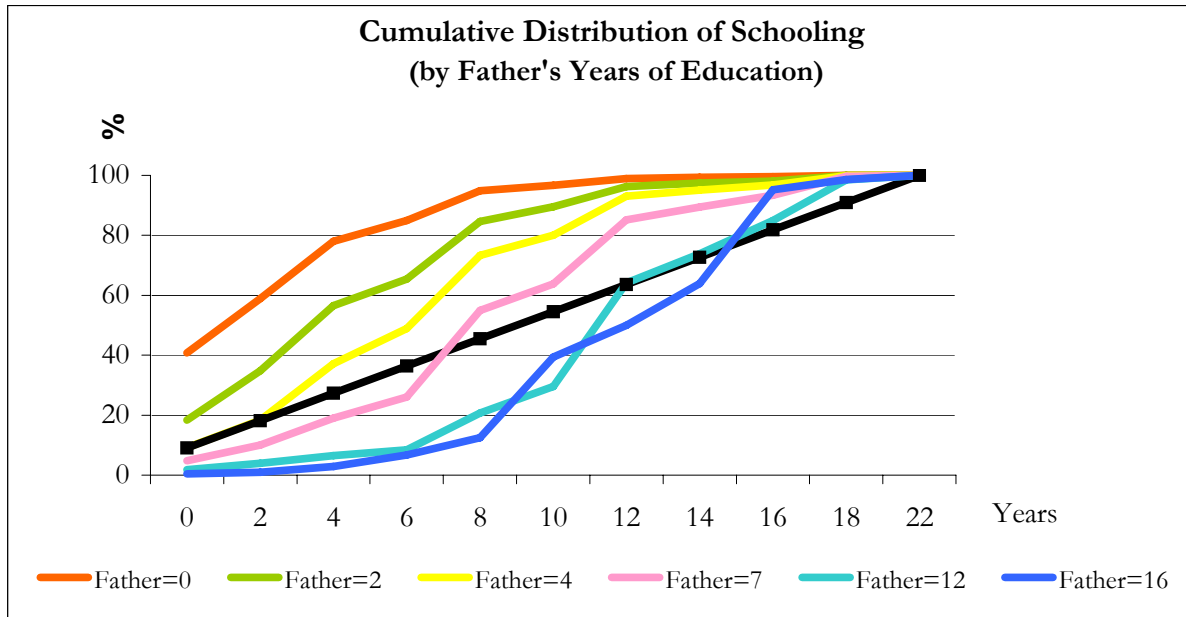
³⁵ Durlauf (1997).

There is an additional ethnicity dimension in the process of transmission educational attainment: indigenous people start the process of acquiring human capital from a disadvantage position since on average, indigenous mothers and fathers are less educated than their white counterparts. Moreover, the data show that as the average number of years of schooling increases, the proportion of indigenous people decreases. For example, while 51% of those with an average of 2 years of schooling are indigenous and 49% white, the percentages are 4% and 96% respectively for those with an average of 14 years of schooling. This seems to confirm the hypothesis that non-whites drop from school sooner, and that indigenous people are faced with a different set of incentives and disincentives to invest in the education of their offspring.

Figures 5 and 6 show the cumulative distribution of education for the whole sample and different subgroups, conditional on parental years of schooling. If the probability of a person attaining a particular level of schooling is not affected by the parent's level of education, then perfect mobility exists. The black 45 degree line represents a situation where, for a given level of parental schooling, children's years of education are distributed evenly across all possible educational outcomes, thus representing perfect mobility. The distance (upwards or downwards) from the cumulative distribution to the 45 degree line can be thought of as a measure of persistence. However, given that the genetic inherited component of ability is correlated with educational attainment, perfect mobility should not be expected even in the presence of a good degree of educational mobility.

Figure 7 -representing the cumulative distribution of years of education for the whole sample conditional on the education of the father-, shows that persistence is higher for children of parents with little or no schooling and less important for children of parents that have completed primary schooling. The implications of persistence at the bottom of the education distribution are highlighted by the fact that the median of parental education is zero years. The probability for a child of uneducated parents to continue in the same educational category is 40%. Having parents that only read and write halves the probability of children having no education down to 18%, while the probability of having zero years of education for children of parents who have primary schooling is of only 4%. Great intergenerational gains in human capital can be made with modest increases in parental schooling.

FIGURE 7: CUMULATIVE DISTRIBUTION OF SCHOOLING



More mobility can be observed at the middle of the distribution: the cumulative distribution for children of parents that have complete primary is the closest to the 45 degree line, with the top 50% having more than 8 years of schooling. Persistence becomes important again at the top end of the distribution: 50% of children born to a parent with higher education will go beyond secondary schooling, compared with only 10% of children born to parents with primary schooling.

5. REGRESSION RESULTS

5.1 Empirical Framework:

We will model mobility through a Markov model in which the value of the variable of interest—in this case educational attainment— for individual i in period t (S_{it}) depends on the value of the variable in the previous period (S_{it-1}) and a stochastic term (u_{it}). The observation for the previous period carries all relevant information about individual i , including transitory shocks.

$$S_{it} = bS_{it-1} + u_{it}$$

The parameter b in this model is positive and greater than one if real growth in S takes place. If S is defined as distance from its mean, then b becomes a measure of persistence and $b < 1$ implies regression towards the mean.

If information for the educational attainment of two consecutive generations is available, the econometric model used to investigate the degree of intergenerational mobility in education –and the transmission of schooling from parents to children- is then given by:

$$S_{ri} = \alpha + \beta S_{pi} + \varepsilon_i \quad (1)$$

where S_{ri} represents the educational attainment of the respondent to the survey in family i , S_{pi} represents the education of the father or the mother of the respondent, and ε_i is a stochastic term with $E(\varepsilon_i) = 0$, $E(\varepsilon_i S_{pi}) = 0$ and $E(\varepsilon_i^2) = \sigma_\varepsilon^2$.

The coefficient β obtained through OLS regression measures the intergenerational persistence of educational attainment. The expression $1-\beta$ is called the degree of regression to the mean, or degree of intergenerational mobility in education. A value of β close to one suggests a very limited degree of intergenerational mobility, whereas a low value of β is a sign that educational attainment is not strongly correlated across generations. Several unobserved factors are incorporated into the value of β , such as individual ability, cultural background, family wealth, spatial segregation related to education quality, and public provision of education³⁶. For this reason, no causal relationship between parental and child education should be inferred, and β will be interpreted as a measure of inequality of opportunity, a mechanism of transmission of the effect of family characteristics –particularly ethnicity- on socio-economic outcomes.

5.2 OLS Results for the Whole Sample

This section reports the estimates of intergenerational mobility obtained for the Guatemala ENCOVI sample. The results were calculated by estimating the model in equation (1) by Ordinary Least Squares. All models included the educational attainment of the respondents of the survey as the dependent variable, and parental years of schooling as the main explanatory variable. A first set of results was obtained for the whole sample, through a basic model using respondent's and father's education and incorporating controls for cohort, gender, ethnicity and area of birth. The mother's level of education was also included as a regressor in order to establish whether father's and mother's education had any differential effect on the educational attainment of the child. Table 6 shows baseline estimations of intergenerational transmission of schooling.

³⁶Checchi (2006).

TABLE 6: OLS Results for the Coefficient of Persistence in Educational Attainment

	Model 1	Model 2	Model 3
Father's education	0.60 ** (0.0)		0.38 ** (0.0)
Mother's education		0.69 ** (0.0)	0.42 ** (0.0)
Dummy Indigenous	-1.37 **	-1.26 **	-1.07 **
Dummy Female	-1.23 **	-1.27 **	-1.24 **
Dummy Rural	-2.02 **	-2.07 **	-1.76 **
Born before 1950	-2.43 **	-2.61 **	-2.32 **
Born 1950-59	-1.09 **	-1.20 **	-1.01 **
Born 1960-69	-0.42 **	-0.52 **	-0.38 **
R-squared	0.485	0.481	0.523
Mean= 4.66			
N= 15,662	*p<0.10, ** p<0.05		

A high coefficient of persistent signals low mobility and inequality of opportunity between individuals in a society; and is more important when the mean of the distribution of schooling is low –as is the case in Guatemala- because it suggests that scarce human capital is concentrated by a few. For example, according to Model 1, the child of a father one year of schooling below the mean of the distribution will be 0.6 years below the mean too. The higher the value of β , the more likely it is that the children of very educated parents acquire education, and that the children of poorly educated ones remain uneducated. The estimate of the coefficient of persistence for the education of the mother (2) was higher, at 0.69, initially suggesting a greater impact of maternal education on the persistence of educational attainment of the respondent. These estimates are consistent with those obtained by

Behrman et al (2001) for other Latin American countries - 0.7 Brazil and Colombia, 0.5 for Mexico and Peru-, as well as with the figure of 0.68 for Brazil obtained by Veloso and Guimães (2003). Still, a β of 0.6 is significantly higher than estimates –ranging from 0.25 to 0.35- obtained for developed countries and discussed in Part I.

By using only the schooling of the most educated parent as an explanatory variable, previous studies fail to take into account the combined effect of the education of both father and mother. The omission of mother's education as an explanatory variable in the transmission of educational attainment can lead to misleading estimates. It is possible that in those cases, the β coefficient would pick up the effect of the education of the other parent and overestimate the degree of persistence, by ignoring the mechanism of transmission of inequality resulting from assortative matching. When both variables were included in the regression (3), similar coefficients of 0.38 and 0.42 were obtained for father's and mother's education, indicating that the effects of father's and mother's education reinforce each other and seem to be of the comparable magnitude. The coefficients are statistically different from each other, suggesting that mothers schooling is more important than father's in terms of persistence.

For the three model specifications, all explanatory variables –including controls for ethnicity, gender, region and cohort - are statistically significant and have the expected sign. The value of R-squared is around 0.48, quite high for a specification with few controls. People born in rural areas have less education when compared to those in cities. Younger cohorts have more schooling than older cohorts, and being born before the last cohort (1970-1979) has a negative effect on average years of education³⁷. Women have on average 1.2 less years of education than men, and the value of the coefficient associated with the dummy for gender does not differ much between the three specifications. The effect of being indigenous on average schooling is negative and significantly different between models. In Model 1, non white respondents have on average 1.4 years of education less than whites. However, when both parental education variables are considered (Model 3), the penalty for being indigenous decreases by 29% to 1 less years of education. This could be explained by the characteristics of the education distribution over time: indigenous women have the lowest level of educational attainment in all birth cohorts, and therefore controlling for the education of the mother decreases the disadvantage particular to indigenous people. The education of mothers appears to be an important channel for the intergenerational transmission of inequality in the indigenous population.

³⁷ Cohort 1: born before 1950; Cohort 2 : 1950-1959, Cohort 3: 1960-1969; Cohort 4: 1970-1979.

5.3 OLS Results by Ethnicity and Gender

The previous results can obscure the influence of ethnicity or gender on the degree of intergenerational transmission of inequality in schooling in Guatemala. To explore this issue, the baseline model was run disaggregating the sample. Results are found in Table 7.

TABLE 7: OLS Results for Persistence in Educational Attainment by Ethnicity and Gender

	Whole Sample	Whites	Indigenous	Male	Female
Father's education	0.38 ** (0.0)	0.36 ** (0.0)	0.44 ** (0.02)	0.40 ** (0.0)	0.35 ** (0.0)
Mother's education	0.42 ** (0.0)	0.42 ** (0.0)	0.46 ** (0.03)	0.40 ** (0.0)	0.44 ** (0.0)
Dummy Indigenous	-1.07 **			-0.65 **	-1.47 **
Dummy Female	-1.24 **	-0.95 **	-1.69 **		
Dummy Rural	-1.76 **	-1.85 **	-1.55 **	-1.83 **	-1.68 **
Born before 1950	-2.32 **	-2.21 **	-2.41 **	-2.44 **	-2.2 **
Born 1950-59	-1.01 **	-0.73 **	-1.43 **	-0.76 **	-1.24 **
Born 1960-69	-0.38 **	-0.12 **	-0.77 **	-0.25 **	-0.50 **
R-squared	0.523	0.496	0.495	0.495	0.54
Mean	15,662	9,618	6,044	7,359	8,303
	4.66	5.84	2.77	5.30	4.09
*p<0.10, ** p<0.05					

In the resulting regressions, all explanatory variables and controls are significant and have the expected sign. The R-squared values were around 0.5 for all models. In the white and indigenous subgroup regressions, the results show that the coefficient of persistence for both father's and mother's education is higher for indigenous respondents (0.44) than for whites (0.36) and the difference is statistically significant. Educational achievement shows more persistence from generation to generation among indigenous people.

Women lag behind men in average schooling in both subgroups. Indigenous women are most affected with an average of 1.7 less years of schooling than indigenous males; while white women have only one year of education less than white men. Given that indigenous women have higher returns to schooling

than males, cultural constraints and discrimination in employment opportunities may explain the differences in the averages. There are also differences between ethnic groups in the effect of cohort of birth: the distance in years of schooling between younger and older cohorts is greater for indigenous people than for whites. Massive increases in the supply of instruction in the second half of the XXth century may have enabled younger indigenous cohorts to shorten the gap in average schooling when compared to whites.

The results of dividing the sample between men and women show that the gender of the child and the gender of the parent matter. The effect of father's education on persistence seems to be more important for males. For females, the effect of mother's education on educational mobility is bigger than that of the education of the father. In the case of girls, the education of the mother may contribute positively to educational mobility by preventing child labour and encouraging the schooling of girls in spite of cultural constraints that tend to discourage women's education³⁸. The finding is in line with other studies in developing countries that suggest that having more schooling allows mothers increased bargaining power, and influences intra-household allocation of resources³⁹.

Mirroring previous regressions, the disadvantage associated with being indigenous is significantly greater for women. While in the model for the entire sample, an indigenous respondent had one less year of education than a white respondent, the penalty for being indigenous decreases to only 0.65 years for males. In contrast, on average an indigenous female has 1.5 less years of education than a white respondent of the same gender, and increase of more than 100% when compared to men. This consistent disadvantage found for indigenous women suggests that indigenous families -which tend to be poorer than white ones-, face liquidity constraints when making schooling decisions and prefer to educate sons rather than daughters, based on limited job market opportunities for indigenous females. As mentioned before, there may also be cultural aspects of the transmission of educational attainment that affect indigenous females in particular, such as the expectation made of girls to assume domestic responsibilities since an early age.

5.4 Analysis by Cohort

In order to explore whether the pattern of persistence in educational attainment had presented any changes over time, separate regressions were run by cohort of birth. The models included controls for ethnicity, area of birth, and gender, defined in the same way as for the previous section. The results are shown in Table 8 in the Appendix. The R-squared coefficients are between 0.46 and 0.5 for all

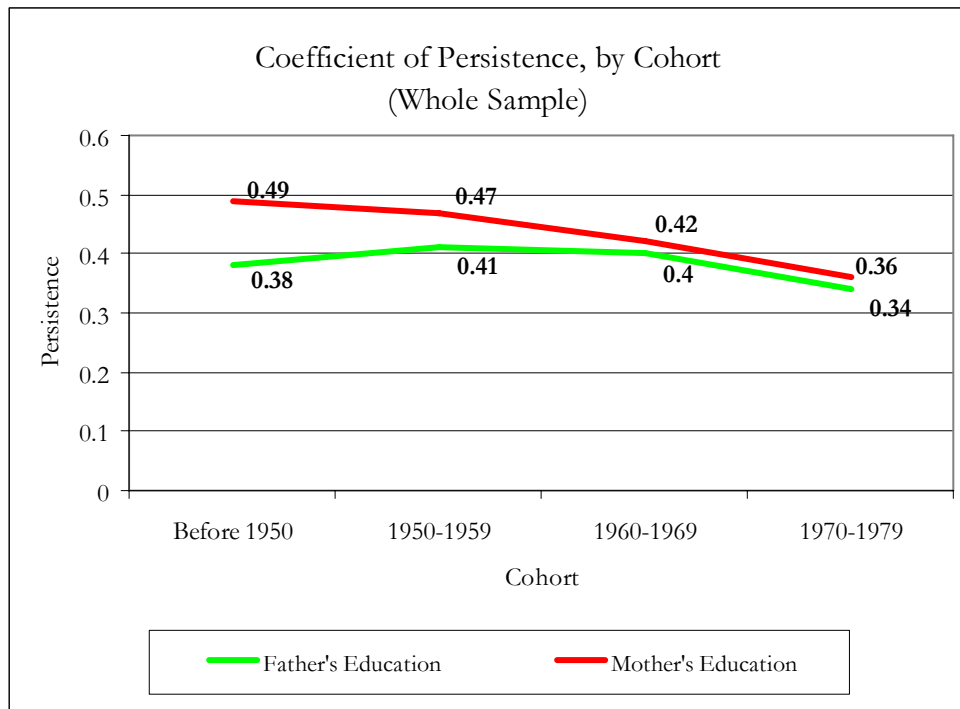
³⁸ For example, Ray (1999) found that the education of adult females leads to a significant reduction in child labour in Peru and Pakistan. Al-Samarri and Peasgood (1997) found that mothers had a relatively stronger preference for the education of daughters.

³⁹ Bourguignon, Ferreira, and Menéndez (2002).

regressions. All variables are significant and have the expected sign. We observe that the average difference in years of education between white and indigenous people remains almost unchanged for all cohorts. Although apparently reducing for the those born between 1970 and 1979, the dummy for being indigenous shows a white person will have on average around 1 additional year of education than an indigenous person, holding all other factors constant. This figure has remained unchanged for the entire twentieth century, in spite of gains in mean level of schooling for both groups. The penalty in years of education for females actually increases over time, with men having on average 1.2 more years of education than women. Rural population is consistently less educated: people born in urban areas have on average almost two additional years of education when compared to people born in rural areas. Overall it seems that persistence is decreasing, but the average difference in the levels of educational attainment for subgroups of the sample remains.

Figure 8 shows the evolution of the persistence coefficient for both parents over time. Social mobility is improving in Guatemala, but at a very slow rate. Younger cohorts have lower levels of persistence for parental education. Although mother's education seems to have a bigger effect than father's education on the schooling of the next generation, the difference decreases over time, converging around 0.35. We observe that the degree of persistence of father's education for each cohort are very close in magnitude and not significantly different from one another. Although the mean of the distribution of schooling increases steadily over time, the overall degree of regression to the mean is not that different between cohorts. The child of a father with one year of education above the mean will have more or less an additional 0.4 years of schooling above the mean for Cohorts 1, 2, 3 and 4; a time span covering those born before 1950 to those born in 1979. The conditional distribution of educational opportunities seems to have remained approximately constant over time with respect to educational family background. This finding would contradict the idea of a substantial "opening up" of opportunities, -and a decrease in the correlation between father's and child's human capital-, in Guatemala in the XXth century, at least without taking into account differences between subgroups.

FIGURE 8: COEFFICIENT OF PERSISTENCE, by COHORT



While the father's coefficient remains without much change, the persistence coefficient on Mother's schooling has decreased consistently over time, perhaps as a result of advances in the education of women during the second half of the XXth century that increased average level of schooling, thus making all mothers in younger cohorts more educated. This educational expansion decreased the relative effect on persistence of having a more educated mother observed for older cohorts.

Looking at different patterns of mobility between the white and indigenous subsamples over time, we find differences according to ethnicity. Figures 9 and 10 in the Appendix show the corresponding graphs. The persistence of Father's schooling for whites is constant at 0.39 years from the mean for whites born in cohorts 1, 2 and 3, decreasing to 0.31 for those born in the last cohort. The coefficient for indigenous people shows greater variation over time, although not a clear pattern. The β for Father's schooling starts at 0.34 for those born before 1950, increases to 0.51 for the second cohort and ends at 0.45 for those born during the 1970's. Indigenous people have a lower level of mobility over time and more variation in its pattern than whites. In regards to the persistence of Mother's education level, there are no clear differences between whites and indigenous children. The coefficients are close to each other for most of the century –between 0.4 and 0.45-, up until the last cohort when the β of the indigenous subsample (0.46) is significantly higher than the one obtained for whites (0.37). Overall, the β associated with mother's education is higher than the Father's for both ethnic groups. The education of mothers, -

operating on persistence through assortative mating and cultural influences-, may be a factor that determines the distribution of opportunities over time.

6.1 Model with interactions

In order to explore specific channels that affect the degree of persistence in educational attainment, interaction terms for ethnicity, assortative matching and gender are added to a model, including the same set of controls as the one introduced in previous sections. The results for the interaction coefficients are shown in Table 9⁴⁰.

TABLE 9: Intergenerational Transmission of Parental Education

	(1)	(2)	(3)	(4)	(5)
Father's education	0.38 ** (0.0)	0.36 ** (0.0)	0.33 ** (0.0)	0.33 ** (0.0)	0.57 (0.0)
Mother's education	0.42 ** (0.0)	0.43 ** (0.0)	0.44 ** (0.0)	0.44 ** (0.0)	0.49 (0.0)
Ethnicity Interaction		0.10 ** (0.0)	0.10 ** (0.0)	0.10 ** (0.0)	0.02 ** (0.0)
Ass. Mating Interaction			0.01 ** (0.0)	0.01 ** (0.0)	0.01 ** (0.0)
Gender Interaction				-0.01 (0.0)	-0.01 (0.0)
Father's Educ Sq					-0.04 ** (0.0)
Father's Educ Cubed					0.0 ** (0.0)
R-squared	0.523	0.524	0.524	0.524	0.528
N= 15,662	*p<0.10, ** p<0.05				

To test whether indigenous people have a different level of persistence than whites, we introduce an interaction term between ethnicity and father's schooling, in addition to the dummy variable for the difference in the intercept. This approach helps to control for the difference in average levels of schooling between the two groups. As opposed to running the regression for whites and indigenous

⁴⁰ The coefficients of all control dummies were significant and of very similar magnitude in all specifications.

separately, the β coefficient will estimate the difference in persistence between a white person and an indigenous person, in relation to the mean of the distribution of education of the entire sample, thus testing equality of opportunity in the society as a whole. Consistent with our previous finding that indigenous people have higher levels of persistence in educational attainment, we find the interaction term to be significant and positive. On average, being indigenous increases the degree of persistence from 0.36 to 0.46 years from the mean, a 28% increase in the value of the coefficient.

By including an interaction term for assortative matching, we can see how the persistence coefficient changes as the distance between spouses' education grows. The assortative matching variable is defined as the absolute value of the difference between the education of the father and the education of the mother, measured in years. At high levels of sorting on education, the value of the variable will be close to zero; with less sorting the value of the variable increases. We find that, on average, distance between partner's education has a positive effect on the degree of persistence. The value of the interaction coefficient is close to zero, but significant in all specifications. In addition, the specification in Model 4 shows no specific differential effect of gender on persistence. These findings seem to contradict our initial hypotheses that assortative matching decreases persistence and that mobility patterns may differ by gender. However, it is possible that the decrease in mobility associated with educational distance between the partners is related to higher educational homogamy found amongst urban and white couples (Quisumbing and Hallman, 2003); therefore catching some of the effect of ethnicity on persistence.

Finally, when non-linearity in the intergenerational correlation in schooling is taken into account by introducing a squared and cubed term for Father's education, we find both terms significant. The cubed terms shows higher levels of persistence at the bottom and at the top of the distribution of schooling. As a result of the change in functional form, the ethnicity interaction term falls in magnitude and stops being statistically significant, implying that the stickiness of education attainment is higher among indigenous people due to the fact that they are mostly found at the bottom of the education distribution (as well as in the unobserved income distribution). There seems to be evidence of a poverty trap, with ethnicity being a proxy for exclusion and lack of opportunity associated with credit constraints.

Given that the previous results arise from the sample as a whole, it is possible that direction of the effect of some variables is different according to ethnicity. For example, previous studies find that assortative matching is more prevalent between white and urban couples, suggesting that whites and indigenous may be also at different ends of the distribution of sorting on parental schooling; but at the same time,

indigenous ethnicity is associated with larger husband education advantage (Quisumbing and Hallman, 2003). If so, running the specification separately for each ethnic group would show differences in the effect of assortative matching on persistence. Table 10 shows the results of estimating the model with interactions separately for whites and indigenous, other control dummies are not reported.

TABLE 10: Model with Interactions, by Ethnicity

	INDIGENOUS	WHITES
Father's education	0.58 ** (0.0)	0.33 ** (0.0)
Mother's education	0.41 ** (0.0)	0.45 ** (0.0)
Ass. Mating Interaction	-0.02 ** (0.0)	0.01 ** (0.0)
Gender Interaction	-0.06 * (0.0)	-0.03 * (0.0)
R-squared	0.405	0.497
N	6044	9618
*p<0.10, ** p<0.05		

The specification shows that the β for indigenous people is twice as high (0.58) than that of whites (0.33). The distance in educational attainment between partners is negatively correlated with the degree of persistence for indigenous people only, reducing the coefficient from 0.58 to 0.56 years from the mean. Differences in educational attainment between parents are positively correlated with persistence in a similar magnitude for whites. Both interaction coefficients are significant at the 5% level. Our hypothesis that sorting on education will increase persistence holds therefore only for indigenous people, but not for whites. The reason why do we observe an opposite effect of the variable on persistence depending on ethnicity is not clear. Mother's education is more correlated with the attainment of children in the next generation for whites. The interaction term between parental education and gender is negative and significant for both whites and indigenous people at the 5% level. Being a woman is correlated with a higher mobility in educational attainment, even after controlling for differences in the average level of schooling between men and women, and for cohort of birth. The

magnitude of the effect is the same -a 10% reduction of the persistence coefficient- for both ethnic groups. The higher degree of mobility observed for white and indigenous females may arise from a “catching up” effect arising from the trend in improvement of the average level of schooling. Given that women born in older cohorts had little access to education, over time females are increasing their schooling the most, relative to previous generations. It may also be the case that males have a higher opportunity cost of education, given the market for child labour.

6.2 Quintile Regression

Most studies of persistence in educational attainment use parametric models (mainly OLS) to analyze the problem, assuming that the effect of the explanatory variables on the degree of persistence is homogenous at all points along the conditional schooling distribution; and that the shape of the distribution is the same as explanatory variables change their value. The results obtained from introducing cubed and squared regressors in the OLS specification make it necessary to examine the non-linearity of the relationship between ethnicity and persistence in schooling through a quantile regression (QR) approach. Instead of minimizing the sum of the squared errors, the quintile regression method minimizes the sum of the absolute value of the errors, fitting curves that leave different percentages of the observations above and below the fitted curve, using the entire sample.⁴¹

Given that educational attainment is generally thought of as an individual completing a number of years or particular a level of schooling; and that the information on educational attainment of both parents and children was codified as an integer variable going from 0 to 23 in the dataset, this paper will use a quantile regression on count data technique following the procedure used by Miranda (2005) and outlined in Machado and Santos Silva (2005).

Count models assume that the shape of the outcome distribution remains unchanged when the value of explanatory variables changes. The Quantile Regression (QR) on count data model requires less distributional and probabilistic assumptions, artificially imposing some smoothness to the discrete count data and making it possible to perform inference using standard quantile regression techniques. This approach does not impose restrictions on the form of the distribution function of education, allowing for different degrees of persistence along the complete conditional distribution, where all individuals are converging to the whole sample mean.⁴² Therefore, it allows for different values of β 's for each quantile

⁴¹ Koenker and Basset (1978, 1982).

⁴² For details of the QR for counts estimator's asymptotic properties and covariance matrix see Machado and Santos Silva (2005).

that can be interpreted as differences in the association between the educational attainment of parents and children at the different points (quantiles) of the distribution of schooling. An intuitive way to interpret the quantile coefficients is assuming there may be unobserved sources of individual heterogeneity that interact with ethnicity, gender and parental schooling at different points of the conditional distribution of the outcome variable, changing the shape of this distribution, and thus mitigating or reinforcing the effect of the explanatory variables on persistence.⁴³ For example, if we consider that unobserved liquidity constraints may interact with ethnicity and gender in terms of persistence, we would expect that in the presence of such constraints, the optimal schooling decision will be affected and therefore we will not only observe individuals coming from poorer families attaining less education, but also that the effect of background characteristics on intergenerational persistence may be different at that point of the realized schooling distribution.⁴⁴ In the same way, in the case of an individual coming from an unconstrained family, we could expect an observation on the right hand tail of the conditional distribution of schooling, and that the effects of gender and ethnicity on persistence at that point, are not necessarily the same as in other points of the distribution.

Table 9 in the Appendix provides coefficients corresponding to quantile regressions for different explanatory variables and controls. We can clearly observe that persistence of Father's and Mother's education changes along the different points of the conditional distribution of schooling. Figure 11 plots both coefficients and the associated 95% confidence intervals. The coefficient of persistence for Father's education is positive and significant along the entire distribution, with increased "stickiness" at the bottom (quantiles 1 through 5). Quantile coefficients are smaller than those obtained from OLS, declining from 0.07 at the beginning to 0.02. Persistence of Father's schooling is larger at the bottom of the distribution, that is, for individuals from liquidity constrained families.

The coefficient of persistence corresponding to Mother's education is also positive and significant for all quantiles and its value is consistently higher than that of Father's education, except for quantiles 1, 2 and 3, where the difference between both coefficients is not statistically significant. The effect of Mother's schooling initially declines, increases at the medium of the distribution (quantiles 5, 6 and 7) and decreases again at the top. If we think that the first 3 quantiles of the distribution correspond to very low levels of education, then it seems the education of the mother has a bigger effect on the decision to finish primary school, for example, rather than the decision to enter school⁴⁵. This variation in the effect would not be evident if using mean regression. Both Father's and Mother's persistence coefficients are more precisely estimated at the top half of the conditional outcome distribution.

⁴³ For a similar interpretation of the effect of unobserved heterogeneity on planned fertility, see Miranda (2005).

⁴⁴ A similar argument can be made for unobserved parental preferences for education as a source of heterogeneity.

⁴⁵ The mean of years of education in quantile 6 is 5.5 years of schooling.

FIGURE 11: COEFFICIENT OF PERSISTENCE: Mother's and Father's Education

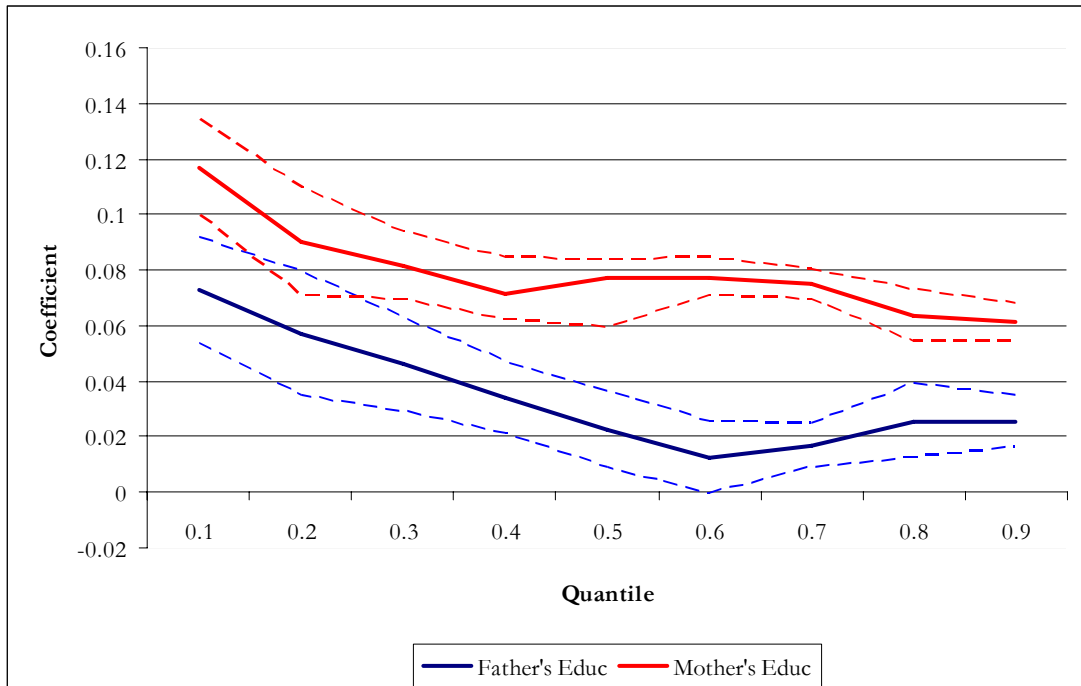


FIGURE 12: COEFFICIENT OF PERSISTENCE and ETHNICITY INTERACTION

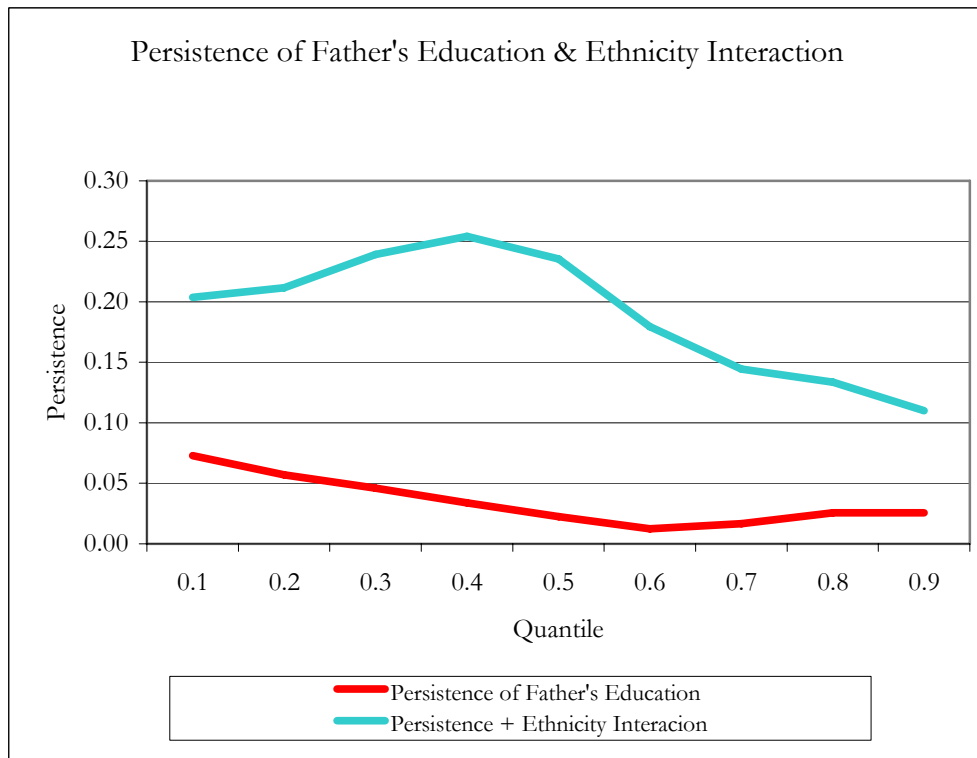
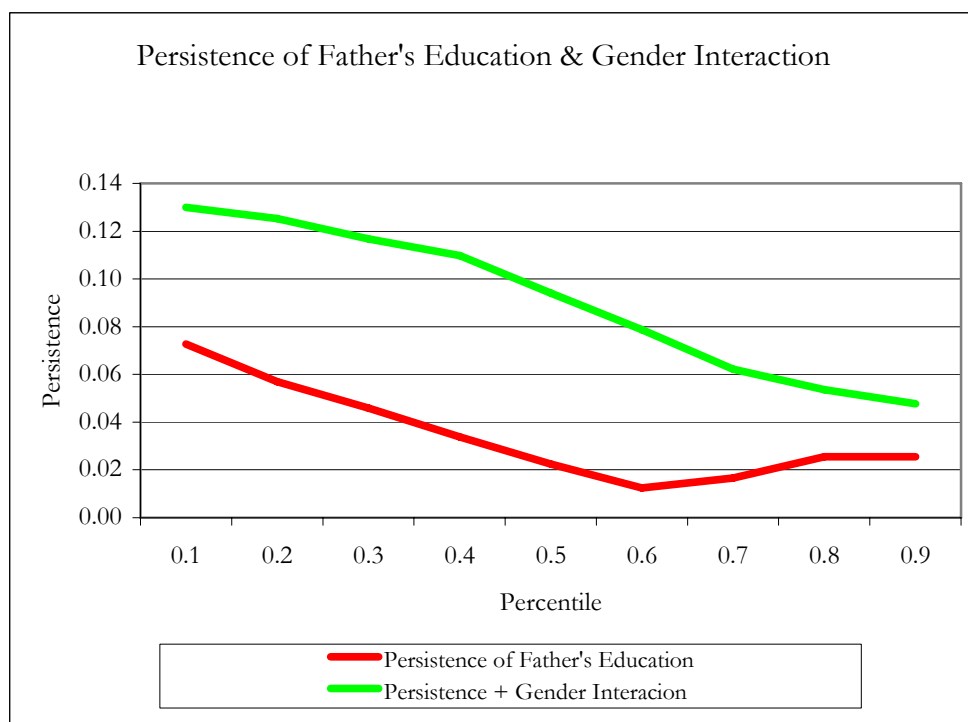


Figure 12 plots the values of the persistence coefficient and the ethnicity interaction. The red line in the graph depicts persistence for whites and the blue line the persistence for non-whites. The results clearly show systematic differences in the degree of persistence in educational attainment according to ethnicity along the conditional education distribution. Indigenous people are less mobile than whites, but the magnitude of the effect of ethnicity on persistence depends on the quintile of the conditional distribution of schooling. The coefficient for the interaction between parental education and ethnicity has a value higher than that of father's or mother's education alone, and at its lowest point (quintile 9), persistence for indigenous people still is 337% higher than for whites. Ethnicity is more important for the first five quintiles; with the magnitude of the interaction coefficient increasing from 0.13 to 0.21 in quintile 5, and then declining to 0.08 in quintile 9. The increasing correlation between parental and child education in the portion of the distribution that correspond to individuals that have at least a few years schooling indicates that parental education matters the most not for those indigenous children that do not go to school at all or go on to finish primary schooling and beyond, but is more important for those who attain incomplete primary education. If we extend the intuition of unobserved factors such as income interacting with individual characteristics to affect persistence, it may seem that ethnicity increases persistence particularly for those families that are neither completely poor or totally unconstrained in terms of credit, but to the marginal family.

FIGURE 13: COEFFICIENT OF PERSISTENCE and GENDER INTERACTION



We can also explore how the effect of ethnicity and gender on persistence varies along the education distribution. Figure 13 plots the values of the persistence coefficient and the gender interaction. The red line in the graph depicts persistence for men in the sample, and the green line the persistence for women. The effect of gender on mobility, captured by the interaction between gender and parental education, is positive and significant for all quantiles of the conditional distribution of schooling. Being a woman decreases mobility relative to a man. The differential effect of being female on the persistence of educational attainment from generation to generation is increasing across the distribution, from 0.057 at the 10th percentile up to 0.022 at the 90th percentile. We could think that it is amongst women coming from more credit constrained families that gender has its stronger effects on persistence. Families in the bottom half of the income distribution may choose to educate boys rather than girls when faced with a liquidity constraint, even after controlling for the education of both the mother and the father. This findings seem to support subsidizing the education of girls in lower income families, as a means of reducing the intergenerational transmission of human capital.

7. CONCLUSIONS

This paper extends the study of the process of intergenerational transmission of educational attainment in the developing world, to include ethnicity as a factor associated with this process. Using several specifications, the results show that educational achievement exhibits higher persistence from generation to generation among indigenous people. The effect of father's education on persistence seems to be more important for males. For females, the education of the mother may contribute positively to educational mobility. The finding is in line with other studies in developing countries that suggest that mother's with more schooling influence intra-household allocation of resources. Cohort analysis shows that social mobility is improving in Guatemala, but at a very slow rate. Younger cohorts have lower levels of persistence for parental education, but the overall degree of regression to the mean is not that different between cohorts. The conditional distribution of educational opportunities seems to have remained approximately constant over time with respect to educational family background. This finding would contradict the idea of a a substantial "opening up" of opportunities, -and a decrease in the correlation between father's and child's human capital-, in Gautemala in the XXth century. Results also show the distance in educational attainment between partners as negatively correlated with the degree of persistence for indigenous people only. Differences in educational attainment between parents are positively correlated with persistence in a similar magnitude for whites. Women seem to be more mobile than men, an effect perhaps arising from a "catching up" resulting from a trend of improvement of the average level of schooling.

Following the methodology outlined by Miranda (2005) and Machado and Santos Silva (2005), we estimate count data quantile regression models. Results from quantile count regression clearly show systematic differences in the degree of persistence in educational attainment across the quantiles of the conditional schooling distribution. Persistence of Father's schooling is larger in lower quantiles of the distribution; Mother's education seems to be more important than Father's in terms of transmission to the next generation; especially in the middle of the distribution, that is for individuals who are observed to have finished primary schooling. Results also indicate that for indigenous children there increasing correlation between parental and child education in the portion of the distribution of education that correspond to individuals that have at least a few years schooling. Surprisingly, women are shown to be less mobile than men in this specification. The differential effect of being female on the persistence of educational attainment from generation to generation is decreasing across the distribution, with a bigger effect in lower quantiles.

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APPENDIX

TABLE 1: STUDIES OF INTERGENERATIONAL MOBILITY AND EDUCATION IN LATIN AMERICA (Part 1)

AUTHOR	DATA	ESTIMATION METHOD	RESULTS						
Behrman, Gaviria, and Székely (2001)	Household surveys including recall data on parental education for Brazil (1996), Colombia (1997), Mexico (1994) and Peru (1985). Data for Mexico and Peru. Sample restricted to 23 to 69 year olds. For comparison, a sample was drawn from the General Social Survey (GSS), pooling observations from 1990 to 1997. Parental education is defined as the education of the most educated parent in the family, that is mostly fathers.	OLS regression of respondent education on parental schooling.	Coefficient of Persistence						
			Brazil	0.70	Colombia	0.70	Mexico	0.50	Peru
Behrman, Birdsall, and Székely (2001)	28 cross-sectional household surveys from 16 countries in LA (excluding Guatemala) ranging from 1980 to 1996. Income for father's income, father's and mother's schooling, and schooling for children aged 10 to 21 is used. A total number of 559 sub samples is analyzed, resulting from 28 surveys, divided in 5 quintiles, and 4 age subgroups.	OLS regression of the Scholing Gap (number of years of school that child and advanced one grade each year, minus the number of years actually observed) on 3 indicators of family background: father's and mother's schooling and household income.	Average Coefficient Estimate						
			Father's Schooling		Mother's Schooling				
			Argentina:	0.046		0.39			
			Bolivia:	-0.09		-0.094			
			Brazil	-0.214		-0.22			
			Ecuador	-0.11		-0.182			
			El Salvador	-0.161		-1.192			
			Honduras	-0.139		-0.299			
Dahan and Gaviria (2001)	Household surveys from 17 Latin American countries carried out during the 1990's . Sample size varies widely between countries. Sample covers children between 16 and 20 years old, only households with two or more children in that specific age range are included in the sample. The study does not cover Guatemala.	Sibling correlations in schooling are calculated to measure differences in intergenerational mobility for 16 LA countries. An index of sibling correlation between family background and educational outcomes is used to explore social mobility.	Correlation of Siblings Scores						
			Argentina	0.44	Colombia	0.59			
			Bolivia	0.56	Mexico	0.59			
			Brazil	0.53	Nicaragua	0.57			
			Chile	0.43	Peru	0.38			
			Ecuador	0.58	El Salvador	0.60			
			Average for LA	0.49	USA	0.20			

TABLE 2: STUDIES OF INTERGENERATIONAL MOBILITY AND EDUCATION IN LATIN AMERICA (Part 2)

AUTHOR	DATA	ESTIMATION METHOD	RESULTS		
Binder and Woodruff (2002)	Data for urban Mexico (Mexico City, Monterrey, Guadalajara, Veracruz, Orizaba and Merida) using the 1994 Gender, Age, Family and Work household survey. Information on educational attainment and employment status of respondents, as well as educational attainment of the head of the family when the respondent was 14. Sample size is 27,792 individuals, restricted to those 23 to 69 years old.	OLS regression of regress years of schooling of the respondent on family characteristics: number of siblings, geographical area, occupation of and father schooling.	Coefficient of Persistence		
			Men	Women	
			Cohort 1	0.79	0.57
			Cohort 2	0.71	0.50
			Cohort 3	0.55	0.42
			Cohort 4	0.34	0.36
Veloso and Guimarães Ferreira (2003)	The authors use the 1996 PNDA Survey (Pesquisa Nacional por Amostras de Domicílios), where a recall categorical question regarding father's education is included. The sample includes all individuals between 25 and 64 for whom there is complete information concerning parent's education, with a total of 43,772 observations.	OLS regression of years of schooling of the respondent with controls for age and age squared, plus dummies for urban areas, ethnicity and region	Coeff. Of Persistence		
			Whole Sample	0.68	
			Urban	0.67	
			Rural	0.72	
			Whites	0.66	
			Blacks	0.72	

TABLE 3 : Ethnicity and Region of Birth (Total and Percentage)

ETHNICITY	URBAN	RURAL
WHITES	5,430 (56.5)	4,188 (43.5)
INDIGENOUS	2,020 (33.4)	4,024 (66.6)
TOTAL	7,450 (47.6)	8,212 (52.4)

TABLE 4: DESCRIPTIVE STATISTICS FOR EDUCATION VARIABLES

	WHOLE SAMPLE	WHITE		INDIGENOUS	
		Men	Women	Men	Women
YEARS OF EDUCATION					
Mean	4.7	6.3	5.4	3.7	1.9
Median	4	6	4	3	0
SD	4.7	4.9	4.8	3.9	3.1
Interquartile range	7	7	7	6	3
EDUCATION OF THE FATHER					
Mean	2.3	3.1	3.1	1.1	1.0
Median	0	2	2	0	0
SD	3.6	4.0	4.1	2.2	2.1
Interquartile range	4	4	4	2	0
EDUCATION OF THE MOTHER					
Mean	1.6	2.4	2.4	0.5	0.4
Median	0	0	0	0	0
SD	3.1	3.5	3.5	1.4	1.5
Interquartile range	2	4	4	0	0
N	15,662	4,478	5,140	2,881	3,163

TABLE 5: CORRELATION COEFFICIENTS, Parental and Child Educational Attainment

WHOLE SAMPLE		
	SCHOOLING	Father EDUC.
SCHOOLING	1.000	
Father EDUC.	0.605	
Mother EDUC.	0.596	0.687
INDIGENOUS		
	SCHOOLING	Father EDUC.
SCHOOLING	1.000	
Father EDUC.	0.465	
Mother EDUC.	0.395	0.490
WHITE		
	SCHOOLING	Father EDUC.
SCHOOLING	1.000	
Father EDUC.	0.598	
Mother EDUC.	0.599	0.682

TABLE 8: Intergenerational Transmission of Parental Education, by Cohort of Birth

	Born before 1950		1950- 1959		1960- 1969		1970- 1979	
Father's education	0.38 (0.02)	**	0.41 (0.0)	**	0.40 (0.02)	**	0.34 (0.02)	**
Mother's education	0.49 (0.02)	**	0.47 (0.0)	**	0.42 (0.02)	**	0.36 (0.02)	**
Dummy Indigenous	-0.98	**	-1.19	**	-1.28	**	-0.89	**
Dummy Female	-0.90	**	-1.62	**	-1.39	**	-1.19	**
Dummy Rural	-1.29	**	-2.11	**	-1.98	**	-1.75	**
R-squared	0.506		0.509		0.489		0.464	
N=	4,159		2,975		3,865		4,663	
Mean	2.71		4.45		5.20		6.09	

*p<0.10, ** p<0.05

TABLE 9: Intergenerational Transmission of Parental Education, Quintile Regression Coefficients

	10th	20th	30th	40th	50th	60th	70th	80th	90th
<u>PERSISTENCE</u>									
Father's Education	0.073 ***	0.057 ***	0.046 ***	0.034 ***	0.023 ***	0.013 *	0.017 ***	0.026 ***	0.026 ***
	-0.010	-0.011	-0.009	-0.007	-0.007	-0.007	-0.004	-0.007	-0.005
Mother's Education	0.117 ***	0.090 ***	0.082 ***	0.073 ***	0.071 ***	0.078 ***	0.075 ***	0.064 ***	0.061 ***
	-0.009	-0.010	-0.006	-0.006	-0.006	-0.004	-0.003	-0.005	-0.003
Ethnicity Interaction	0.131 ***	0.155 ***	0.193 ***	0.220 ***	0.213 ***	0.167 ***	0.128 ***	0.108 ***	0.085 ***
	-0.007	-0.009	-0.015	-0.014	-0.015	-0.011	-0.008	-0.007	-0.008
Ass. Match. Interactor	0.005	0.004	0.001	0.003	0.004	0.009 *	0.011 ***	0.007	0.004
	-0.005	-0.007	-0.009	-0.005	-0.006	-0.006	-0.003	-0.005	-0.004
Gender Interaction	0.057 ***	0.068 ***	0.071 ***	0.076 ***	0.072 ***	0.066 ***	0.046 ***	0.028 ***	0.022 ***
	-0.006	-0.006	-0.008	-0.006	-0.006	-0.005	-0.004	-0.005	-0.005
<u>CONTROLS</u>									
Dummy Indigenous	-1.2384 ***	-1.3468 ***	-1.4032 ***	-1.3912 ***	-1.2648 ***	-0.9321 ***	-0.6992 ***	-0.5954 ***	-0.4315 ***
Dummy Gender	-1.0116 ***	-1.0245 ***	-0.9162 ***	-0.8675 ***	-0.7334 ***	-0.6076 ***	-0.4538 ***	-0.3302 ***	-0.2752 ***
Born before 1950	-1.3532 ***	-1.4153 ***	-1.3138 ***	-1.1688 ***	-1.0584 ***	-0.8881 ***	-0.6921 ***	-0.5628 ***	-0.4551 ***
Born 1950-1959	-0.6408 ***	-0.5607 ***	-0.4829 ***	-0.4567 ***	-0.4014 ***	-0.3091 ***	-0.223 ***	-0.1912 ***	-0.1233 ***
Born 1960-1969	-0.2458 ***	-0.2163 ***	-0.1612 ***	-0.1064 ***	-0.0871 ***	-0.0746 ***	-0.0681 ***	-0.0545 **	-0.0101
Constant	0.189 **	0.9975 ***	1.3813 ***	1.6481 ***	1.836 ***	1.9263 ***	1.9949 ***	2.1205 ***	2.287 ***
Observations	15662	15662	15662	15662	15662	15662	15662	15662	15662

* p<0.10, ** p<0.05, *** p<0.01

FIGURE 1: EDUCATIONAL ATTAINMENT, by educational category

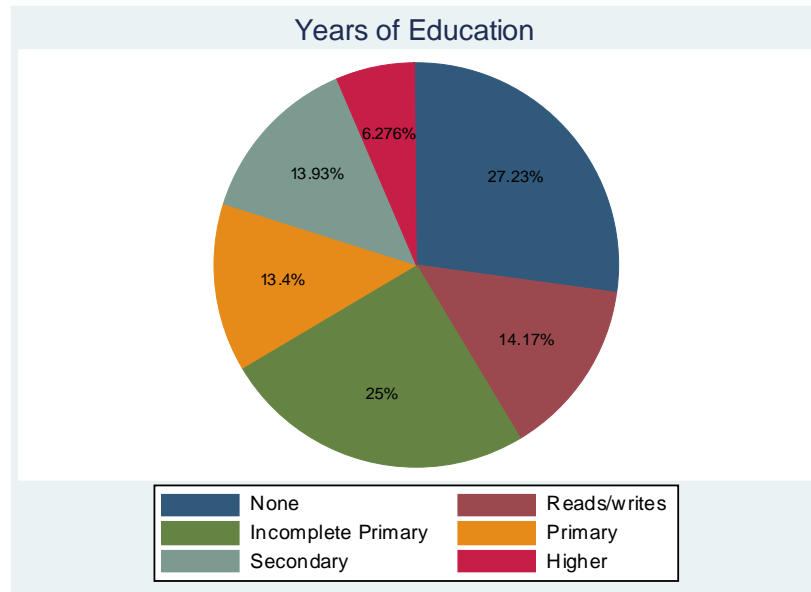


FIGURE 2: EDUCATION DISTRIBUTION IN GUATEMALA, by Ethnicity

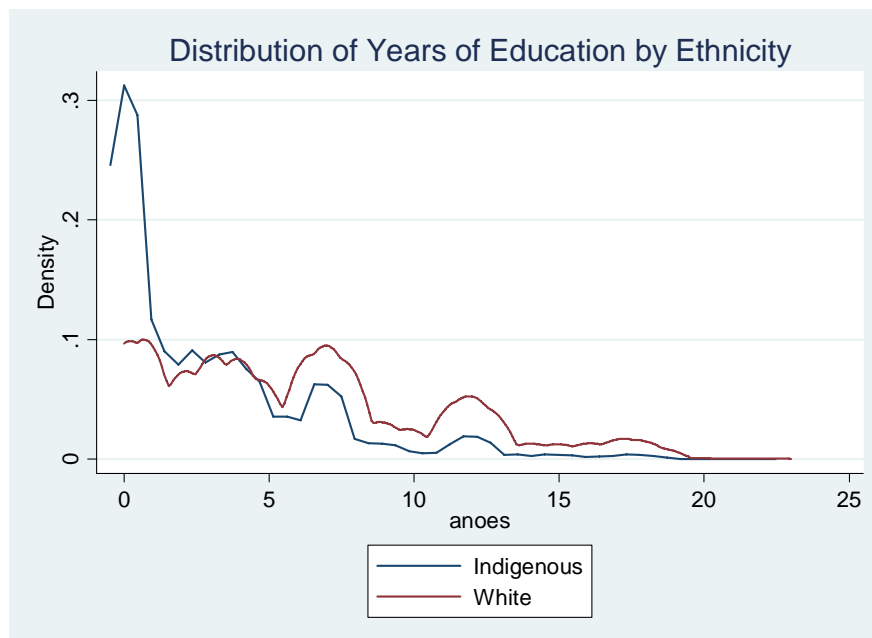


FIGURE 3: PROGRESS IN EDUCATIONAL ATTAINMENT, BY COHORT

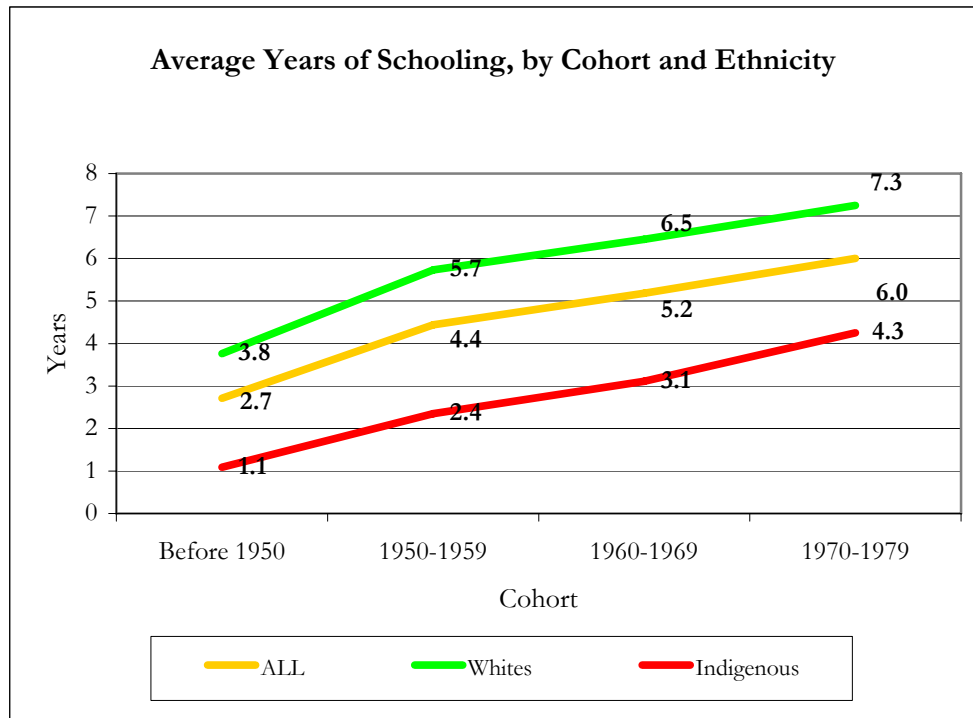


FIGURE 4: AVERAGE YEARS OF EDUCATION, by Father's Schooling

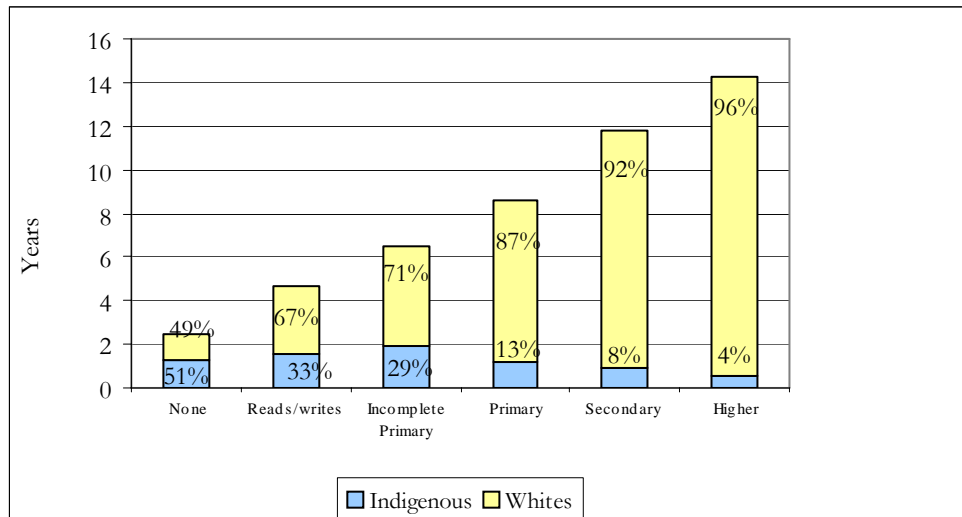


FIGURE 5: CUMULATIVE DISTRIBUTION OF SCHOOLING, Indigenous

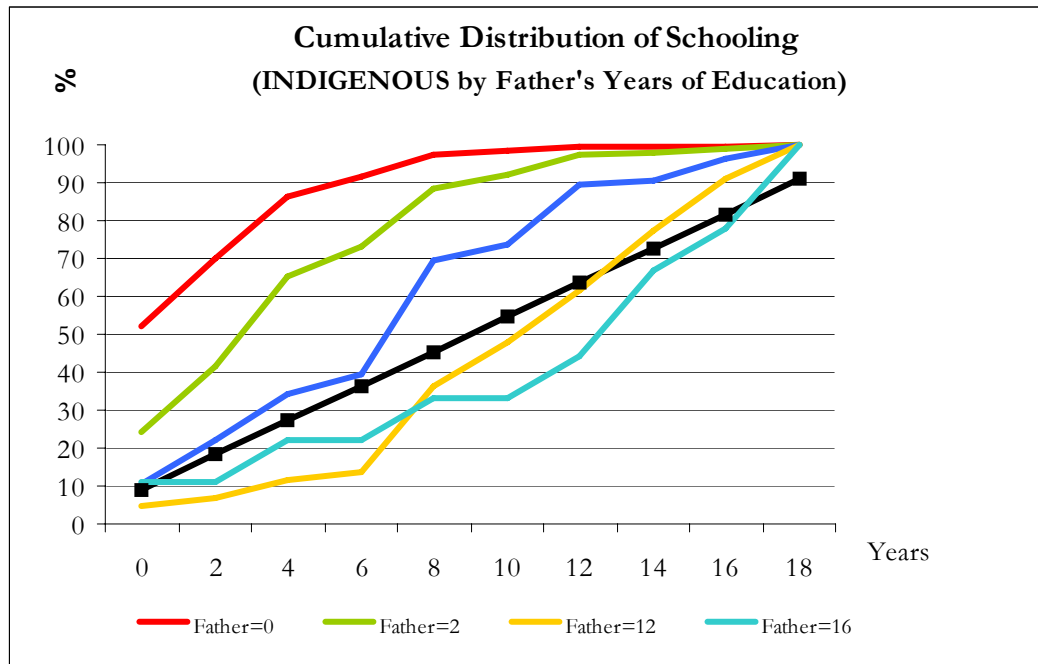


FIGURE 6: CUMULATIVE DISTRIBUTION OF SCHOOLING, Whites

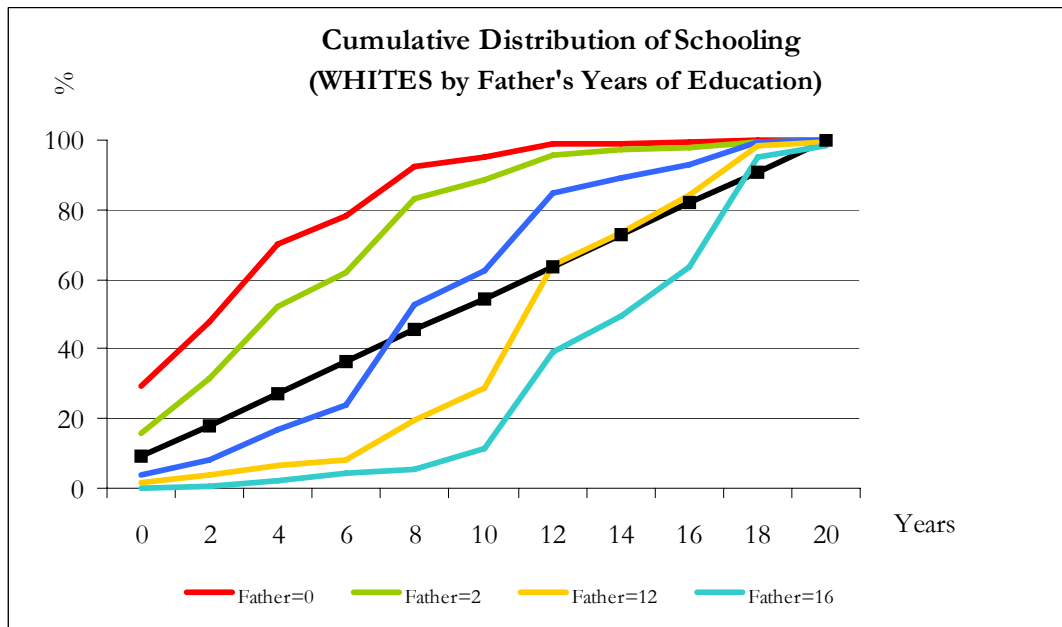


FIGURE 9: PERSISTENCE OF FATHER'S EDUCATION, by Cohort and Ethnicity

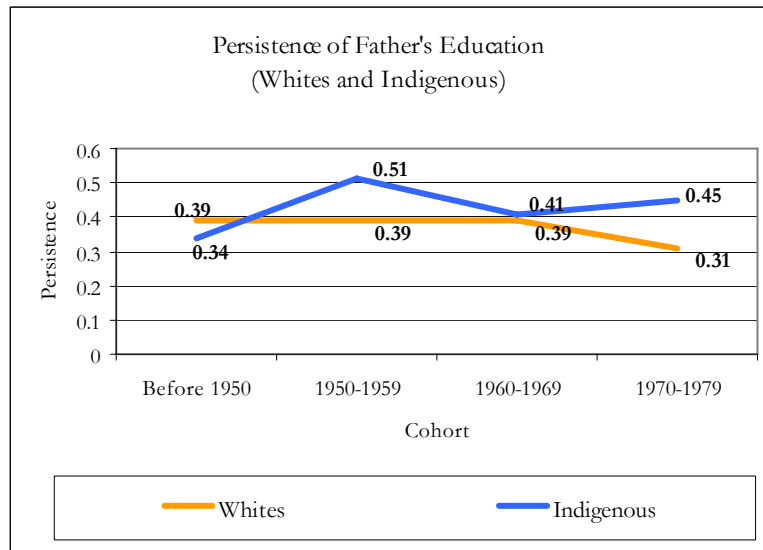


FIGURE 10: PERSISTENCE OF MOTHER'S EDUCATION, by Cohort and Ethnicity

