The Impact of Family Size on Educational Attainment in Costa Rica

I. INTRODUCTION

It is widely understood that education is an essential component to the development of any society. A more educated population leads to a more advanced health care system, more efficient use of resources and, generally, more wealth for the entire economy. Therefore, it is vital that the adult population of any developing nation today invests in the education of their children if they wish to expand their economy. Over the past twenty years, conditional cash transfer programs have begun to address this issue by offering stipends to families with school-age children, provided that these children have documented regular attendance in school. These programs have been especially popular in Latin America where Progresa, the cash program in Mexico, exhibited wonderful success in its preliminary stages starting in 1998. Since then, these programs have spread like wildfire throughout Latin America, with individual countries adapting the model slightly to meet their own needs. The hope is that these conditional transfers can replace the wages children might earn from working or helping with the family business, and thus reduce or eliminate the family's opportunity cost of sending these children to school.

Still, questions remain regarding the magnitude of the opportunity cost of attending school, and regarding the components that create this opportunity cost. Is the opportunity cost of attending school higher for families with fewer children, where each child's work has a greater marginal return to the family's income? Or, do these families have fewer children because they do not need as much help generating a sustainable income, hence diminishing the effect of the children's contribution to family income? Is family size simply a result of the family's income level prior to having children; that is, are a family's fertility decisions independent of the future income these children may generate? These are the types of questions that this analysis seeks to answer in the context of Costa Rica. The paper proceeds as follows: Section II describes the

theoretical and empirical motivation for studying this question, and specifically, for studying Costa Rica. Section III describes the data and methodology used to answer these questions, Section IV describes trends in the data, Section V presents and interprets regression analysis results, and Section VI concludes.

II. MOTIVATION

Gary Becker's theory on the quantity and quality of children describes a negative relationship between the quantity of children a family has and the quality, or amount of investment, which the parents put into each child. Becker and Lewis argue that this inverse relationship results from the increasing shadow price of a child as the level of quality of children increases (Becker, 280). Taken in the context of education, this theory implies that families who desire higher levels of education for their children will have fewer children due to the fact that they will have to pay more for each child's education as the level of education rises. Empirical studies have also found this relationship to be true. For example, Lam and Duryea find a negative relationship between parents' schooling and fertility in Brazil. They link this relationship to an increase in the level of schooling of each child in the family. At lower levels of schooling, this decrease in fertility results from an increase in child quality, which is measured by an increase in schooling (Lam and Duryea, 176).

A study of this phenomenon in Costa Rica is unique because of specific characteristics of Costa Rica, some which separate it from some its Latin American neighbors. First of all, its literacy rate is one of the highest in Latin America at 96 percent. According to the CIA World Factbook, the 2006 literacy rate in Brazil is 88 percent, 91 percent in Mexico, and 67.5 percent in Nicaragua. Secondly, it has a young population, with nearly 30 percent of its population under

the age of 14, and a median age of 26.2. With a population growth rate of 1.8 percent in 2007, the relationship of family size and education level certainly affects a large subset of the population. To compare, growth rates in Brazil and Mexico are 1.0 percent and 1.1 percent, respectively, whereas the growth rate in Nicaragua is 1.9 percent (CIA Factbook). Therefore, while Costa Rica has literacy rates that are similar to more developed countries in Latin America, it behaves like smaller, less developed countries in terms of population growth. For these reasons, it poses an interesting case to study.

Additionally, the relationship between family size and education in Costa Rica is interesting because a conditional transfer program, called Superémonos, implemented in 2001 found that providing one monthly food coupon to selected Costa Rican families if all children between 6 and 18 attended school increased school attendance among these families by 2.9 percentage points, an effect equivalent to increasing the mother's education by six years. However, when comparing the mean attendance rate of families who received transfers to those who did not receive a transfer, the difference was not found to be significant (Duryea and Morrison, 11-12). While there could be several explanations as to why there is no significant difference in mean attendance rates, this impact evaluation is perhaps the greatest motivator for analyzing the relationship between family size and educational attainment. Regression analysis captures a bit of the opportunity cost of sending a child to school, but the lack of significant difference in means could suggest that perhaps one food coupon per family, regardless of the number of children between 6 and 18 might not always be an effective motivator to send children to school. The next sections explore family size in Costa Rica in more detail, in hopes of deepening the understanding of this relationship.

III. DATA AND METHODOLOGY

In order to look at these questions, this paper uses IPUMS census data from Costa Rica in 1973, 1984 and 2000. The three years of data will provide a cross-sectional analysis of education and family size over time. To begin, it is important note drastic changes in demographic trends over time. Latin American women averaged approximately 6 births in 1950, but fertility rates have decreased rapidly over the past fifty years to hovering just above replacement fertility in 2000 (Population Reference Bureau). Therefore, each year will provide an interesting contrast in comparing family size and education, holding other factors constant. The entire population of individuals with education information available in 1973 is 154,885. The sample size increases to 208,958 in 1984, and 343,642 in 2000. The mean age of the sample in 1973 is 26, increasing to 27 in 1984 and 30 in 2000. In other words, the population is aging slowly over time.

Variables included in the IPUMS dataset that are especially important to this analysis include educational attainment, representing the current (or completed) level of education of every person in the household, and the variable indicating the number of people in each household. Those who are have no education information listed, most likely children under age 6, are excluded from the sample. In this analysis, the number of children born to a child's mother is used as a proxy for the number of siblings that child has, and in this case the number of children born is interpreted as a measurement of family size. It is important to note the assumptions when using number of children born to the mother as a proxy for the number of siblings. In certain cases, some of those children born to the mother may no longer be alive, or some of these children may be half brothers or sisters that do not live in the same household. Obviously, these absent children have no impact on the observed child's educational attainment.

Still, this variable attempts to capture some of the possible competition between siblings for the opportunity to go to school, if parents need one child to stay at home or work. In additional specifications, the number of people per household is understood to be another measurement family size, although in some cases multiple generations may live in one household, or the household may contain people who are not directly related to children in the family. One additional model is run using this measure of family size as a sort of robustness check to the effect of number of siblings.

Educational attainment is grouped into four categories: less than primary, primary, secondary and university. Most analyses will use years of school in place of this variable for a more accurate interpretation of effects. When years of school is used, 6 years of school can be compared to completing primary school, and 11 years of school generally is understood to correspond to completion of secondary school. Any additional years of education indicate participation in some type of specialized technical education or university. Other variables to be used as controls in regression analysis include an indicator for whether families live in an urban or rural neighborhood, and a proxy for income. While the IPUMS data on Costa Rica does not include information on household income, this analysis uses home ownership, availability of electricity and possession of a refrigerator as proxies for income. Certainly, these variables cannot be interpreted as any monetary equivalents of income, or even as a continuous distribution of income levels. They simply group the population into a higher income and lower income bracket. In other words, if a household owns its home rather than rents its dwelling, has electricity and has a refrigerator, it is assumed to be a higher income household than a household that does not possess these basic durable goods.

Analysis will focus on children ages 9 to 15 as a whole, and the older subset of this age group, children 14, 15 and 16. On average, children ages 9 to 15 are most likely both still living with their parents and attending school, so there may not be as much variation in educational attainment in this population group. However, as children reach their early teenage years, their probability of working increases, especially after the completion of primary school. Children in this age group are old enough that, should the family need extra help earning money or working in a family business, parents could pull these children from school to work more easily than they could pull younger children from school.

These variables will be used to study the relationship between family size and educational attainment by comparing trends of family size over time, by level of education and with control variables. Then, multivariate ordinary least squares regressions will estimate effects across the entire age group by year, including only children ages 14-15 by year, analyzing children aged 16 separately, pooling all years together. One final robustness check will number of people living in a household as a robustness check for the effect of family size.

IV. TRENDS IN FAMILY SIZE AND EDUCATION IN COSTA RICA

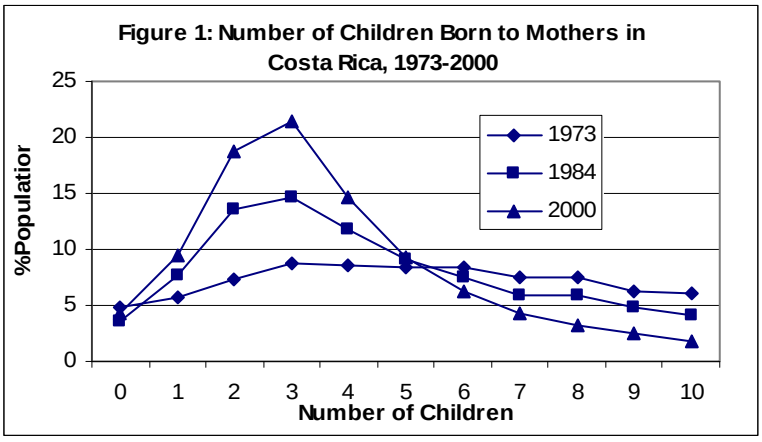
Before analyzing the effects of these variables on educational attainment with regression analysis, it is important first to gain a picture of the relative trends and distributions of families in Costa Rica. To begin, Table 1 presents the mean values of important variables in the sample in each of the three years studied. As seen in this table, the population in 2000 is older, more urban, with smaller families, more schooling and more household durables than the population in 1973 or 1984. The following figures investigate these changes further.

Table 1: Mean Characteristics, by Year

Year	Age	Household Size	Number Siblings	Schooling (Years)	% With Electricity	% Owning Home	% owning a Refrigerator	% Urban Areas
1973	26.32	7.18	6.76	4.45	0.67	0.65	0.27	0.42
1984	27.83	5.88	5.38	5.44	0.82	0.70	0.54	0.45
2000	30.21	4.84	4.04	6.35	0.97	0.74	0.85	0.60
All three years	28.65	5.66	5.04	5.67	0.86	0.71	0.63	0.51

Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Statistics represent mean values of variables in the individual year. The final row includes means across all three years of data.

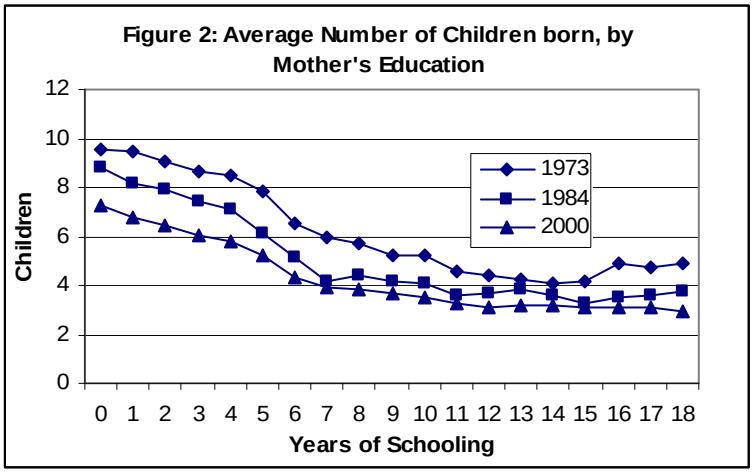
Figure 1 shows the changes in the distribution of family size over time. This graph shows a relatively normal distribution of children born across all years, although this distribution is slightly skewed to the left. Furthermore, this graph shows a clear decline in the variance of the number of children born to women in Costa Rica over the three years surveyed. In 1973, approximately 44 percent of women in Costa Rica had at most five births over their lifetime; by 2000 this percentage increased to nearly 78 percent, with 40 percent of those women having only two or three births. This shows quite clearly the women's changing preferences of childbearing over time.



Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica.

When looking at the mean number of children born to mothers Costa Rica by years of education, it is clear that schooling adds another dimension to this relationship. Not only is the

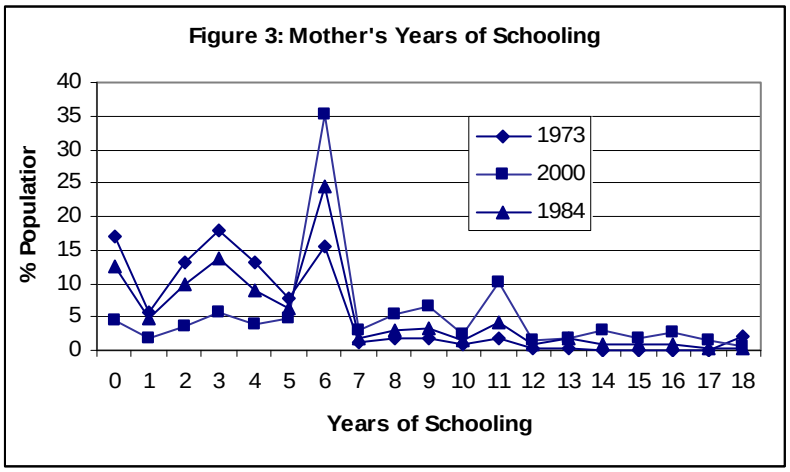
number of children born to Costa Rican women decreasing with her level of education, but the average number of children born to women at each level of education is decreasing over time. While this graph suggests that households where the mother has higher levels of educational attainment are generally smaller than those where the mother has less education, it does not shed light on the causal relationship between these two factors. This highlights the need to separate the effects over time from the effects of educational attainment to determine if smaller households result in family members attaining higher levels of education, or if these two factors are simply correlated, but caused by some third variable, such as income.



Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica.

These two graphs naturally beg the question of the distribution of educational attainment over time. Because it appears that family size is negatively correlated with educational attainment and over time, it is very plausible that the population of Costa Rica is becoming more educated over time, thus explaining these two results. In fact, this is exactly what the data shows. Figure 3 shows the highest level of education attained by mothers of children ages 9-15 over time. The sample was limited to the education of mothers with children ages 9-15 due to the direct impact of their education on the children to be analyzed in the regressions in this paper. As seen below, approximately 15 percent of mothers completed six years of education, or

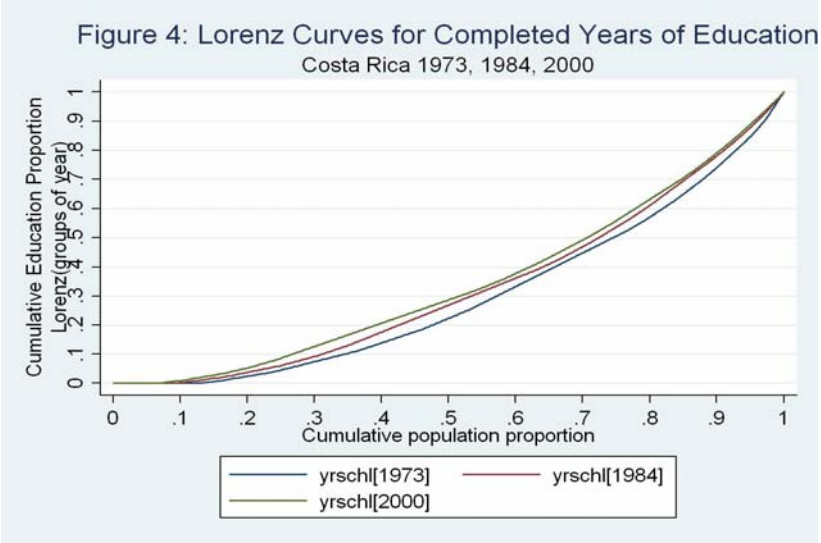
primary school, in 1973. This number grows to 25 percent in 1984 and 35 percent in 2000. Approximately 10 percent of mothers complete secondary school in 2000. Additionally, the percentage of mothers completing more than 11 years of education increases from approximately 2 percent in 1973 to 6 percent in 1984 and 12 percent in 2000. This shows that mother's education is increasing over the same period of time during which they are experiencing decreasing fertility.



Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Mothers represented here are those with children ages 9-15 in the year of the survey. Schooling level shown is the maximum level of schooling the mother in each household has attained.

In order to examine whether the level of schooling has risen unambiguously in Costa Rica over time, Figure 4 shows a Lorenz Curve of the years of completed schooling for individuals over age 15. Because the top line in this graph represents the year 2000 and the bottom line represents 1973, it is clear that the distribution of education in Costa Rica becomes increasingly more equalized from 1973 to 2000 because these lines do not cross. Still, the magnitude of the gains in equality over the entire period is relatively small. This graph confirms the aforementioned conclusions that the population of Costa Rica has become more educated over time. However, all three curves remain very close together and are clearly concave; indicating that more work needs to be done to equalize education in Costa Rica.

It is also useful to briefly analyze the breakdown of educational attainment and family size across different control groups. For example, Table 2 shows the mean years of schooling and standard deviations across the three income proxy variables and across the indicator for urban households. This provides a basic understanding of how educational attainment varies across different income groups, even if income is not explicitly described by these proxies. Also, this table represents mean years of schooling over all three census years.



Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Yrschl=Years of Schooling. Sample is limited to individuals over the age of 15, to be interpreted as individuals who have completed their education. Top curve in the graph represents 2000, the middle curve represents 1984, and the bottom curve represents 1973.

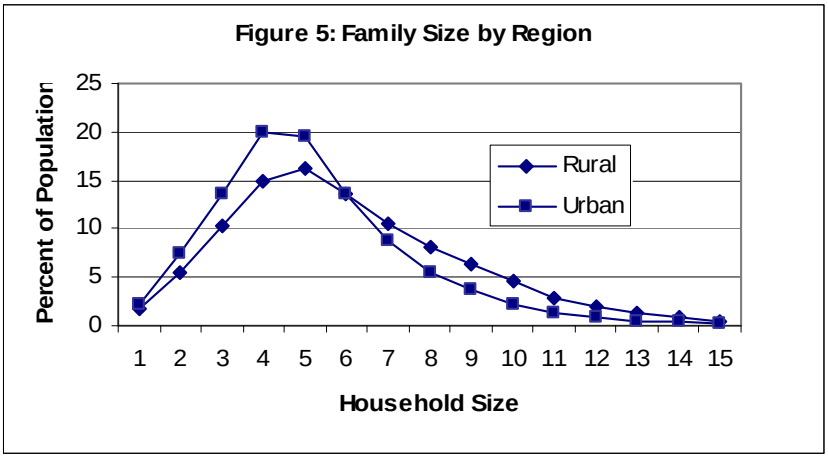
Table 2: Mean Years of Schooling, by Income Proxy and Location

	Refrigerator	Electricity	Own Home	Urban Area
No	3.9	5.4	3.0	4.4
	(3.0)	(4.1)	(2.6)	(3.4)
Yes	6.7	5.8	6.1	6.9
	(4.4)	(4.2)	(4.2)	(4.4)

Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Standard Deviations show in Parenthesis. Means taken across all three years of the sample. However, it is important to recall that, as shown in Figure 1, the proportion of the population answering "yes" to all four of the above characteristics increases over time from 1973 to 2000.

Intuitively, as shown by the previous figures, one can assume that these means would be higher if the sample were limited to include only 2000, and lower if the sample included responses only from 1973.

As shown by this table, the average number of years of schooling nearly doubles in households that have a refrigerator or electricity. While the effect is not as large for a household owning its dwelling, there still is a positive effect. This confirms that the three binary variables selected serve as a good proxy for income, since literature shows that higher income families generally have higher levels of education. When looking at the corresponding means for urban locations compared to rural locations, Table 2 shows that households in urban areas have, on average, 2.5 more years of education than households in rural areas. Again, this relationship is paired with smaller households in urban areas compared to rural areas, as seen in Figure 5 below. Nearly 40 percent of the urban population of Costa Rica has a household size of 4 or 5 people, compared to approximately 30 percent of the rural population. These two distributions are marked by similar skews as the previous figures.



Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Relationship above presented across all three years of the sample. Again, Table 1 shows that the households become smaller and increasingly urban over time.

Hence, all of these trends and summary statistics indicate that households in Costa Rica that are smaller, richer and urban have higher levels of education than those that are not. The next section employs regression analysis in order to tease out the magnitude of these effects, as well as the importance of family size in consideration with these other factors.

V. REGRESSION ANALYSIS

Initial ordinary least squares regressions were run on years of education, controlling for number of siblings, age, age squared, sex, mother's schooling, father's schooling, urban areas, owning a refrigerator, owning a home, and having electricity. Separate models were run for children ages 9-15 in each year of the survey. The coefficient of greatest interest for this analysis is the coefficient on the child's number of siblings in the household, and the other variables simply serve as controls. The results of this regression are shown in Table 3 below.

The first, most striking observation is that all of these variables significantly explain some of the variation in years of schooling. Additionally, the negative coefficient on the number of siblings is increasing over time. While the coefficients are statistically significant, the substantive significance of these statistics is quite small. For example, the coefficient on the number of siblings in 2000 means that increasing the number of siblings a child has by one decreases the number of years of schooling of a child ages 9-15 by 0.09 years. In other words, increasing the number of siblings by 10 decreases the years of schooling of a child ages 9-15 by one year. However, as seen previously by Figures 1 and 2, the average number of children born to a woman in 2000 is less than eight, across any level of educational attainment. Therefore, it is unlikely that a child's number of siblings would have a large effect on their educational attainment.

Table 3: OLS Regression Coefficients, by Year

	1973	1984	2000
	(1)	(2)	(3)
Number of Siblings	-0.041	-0.054	-0.094
	(17.23)**	[19.60]**	[31.88]**
Age	1.643	1.915	1.512
	(28.86)**	[33.49]**	[35.06]**
Age Squared	-0.041	-0.048	-0.031
	(17.43)**	[20.05]**	[17.00]**
Male	-0.130	-0.218	-0.193
	(7.97)**	[13.18]**	[15.59]**
Mother's Ed	0.181	0.157	0.269
	(10.29)**	[17.60]**	[20.09]**
Father's Ed	0.177	0.281	0.186
	(10.48)**	[11.07]**	[27.51]**
Urban	0.103	0.063	0.060
	(4.81)**	[3.03]**	[4.42]**
Owns Home	0.241	0.242	0.316
	(13.50)**	[12.73]**	[21.36]**
Electricity	0.634	0.485	0.265
	(30.94)**	[20.39]**	[7.43]**
Refrigerator	0.353	0.400	0.482
	(14.79)**	[18.86]**	[22.88]**
Constant	-9.939	-12.399	-10.303
	(29.70)**	[36.72]**	[40.25]**
Observations	29033	27523	44070
R-squared	0.52	0.59	0.62

Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Absolute value of t statistics in parentheses. * Significant at 5%; ** significant at 1%. Dependent variable is years of schooling of children ages 9-15. Ordinary Least Squares regressions used.

In Figure 4, children ages 16 were examined separately to investigate if older children's education is more sensitive to changes in the number of siblings. The coefficients on number of siblings for sixteen year olds are slightly larger when compared to those from children ages 9-15, but the coefficients suffer from the same questions of substantive significance as in the previous model. However, it is interesting to note that coefficient on being male is negative, and that the magnitude of this coefficient is larger for 16 year old boys than it is for boys ages 9-15. This

coefficient demonstrates the diminishing returns of schooling for boys; after age 15, the opportunity cost of attending school is significantly larger than it is for younger children. Hence, many boys over age 15 drop out of school to work, or are encouraged to do so by their families. This fact is compounded slightly by one additional child in the family, increasing the negative effect of being male on schooling in larger families.

Table 4: OLS Coefficients, Age 16 Only

	1973	1984	2000
	(1)	(2)	(3)
Number of Siblings	-0.061	-0.077	-0.101
	(6.27)**	[7.65]**	[8.86]**
Age	0.000	0.000	0.000
	(.)	[.]	[.]
Age Squared	0.000	0.000	0.000
	(.)	[.]	[.]
Male	-0.128	-0.423	-0.470
	(1.85)	[6.53]**	[9.08]**
Mother's Ed	0.341	0.388	0.528
	(4.34)**	[9.52]**	[11.10]**
Father's Ed	0.491	0.620	0.431
	(6.73)**	[6.98]**	[13.07]**
Urban	0.636	0.507	0.311
	(7.16)**	[6.52]**	[5.48]**
Owns Home	0.291	0.399	0.468
	(3.78)**	[4.98]**	[7.04]**
Electricity	1.038	0.859	0.503
	(11.75)**	[8.64]**	[3.03]**
Refrigerator	0.722	0.779	0.677
	(7.63)**	[9.49]**	[7.26]**
Constant	4.521	4.658	4.422
	(26.87)**	[28.00]**	[23.69]**
Observations	3037	3697	5073
R-squared	0.32	0.32	0.27

Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Absolute value of t statistics in parentheses. * Significant at 5%; ** significant at 1%. Dependent variable is schooling of children ages 16.

In Table 5, the samples from all three years are pooled into one model, and dummies for 1984 and 2000 are added to account for variation in education levels over time and other unexplained year effects that could affect educational attainment in a given year of the survey. As different controls are introduced into the model, and interesting result emerges. While in the first specification, the coefficients on years 1984 and 2000 are positive, indicating that the level of education is increasing over time, the signs on these coefficients are reversed once parents' education and the number of siblings are included in the model. Not only is the sign reversed, but the magnitude of the effect of years 1984 and 2000 increases. This is contrary to what is expected, one would expect these additional controls to absorb some of the variation of educational attainment over time. This changing sign suggests the possibility of the presence of multicollinearity in the regression; that is, the fact that parents' education is highly correlated with the later years of the sample, 1984 and 2000.

In fact, Figure 2 exhibits this multicollinearity through the fact that the number of children born to mothers is decreasing both over time, and by the mother's years of education. This illustration, combined with the changing signs on coefficients as shown in Table 5 make a strong case for the presence of multicollinearity as the reason for the confusing the results. Again, the coefficients on number of siblings are negative and significant, but substantively small. In order to examine one more measure of household size, the variable for number of children was replaced by the variable indicating number of people in a household. Results are shown in Table 6 below.

Table 5: Pooled OLS Regression Coefficients

	(1)	(2)	(3)
1984	0.123	-0.191	-0.295
	(10.57)**	[15.75]**	[24.52]**
2000	0.288	-0.471	-0.711
	(27.67)**	[38.12]**	[55.20]**
Age	1.583	1.643	1.641
	(52.79)**	[54.02]**	[55.33]**
Age Squared	-0.036	-0.037	-0.038
	(28.52)**	[29.27]**	[30.37]**
Male	-0.199	-0.186	-0.182
	(23.08)**	[21.21]**	[21.37]**
Number of Siblings		-0.075	-0.058
		[49.68]**	[38.20]**
Mother's Ed		0.354	0.264
		[46.41]**	[25.60]**
Father's Ed		0.272	0.182
		[38.37]**	[34.63]**
Owns Home			0.28
			[28.56]**
Electricity			0.514
			[37.67]**
Refrigerator			0.39
			[31.65]**
Urban			0.07
			[6.91]**
Constant	-9.246	-9.928	-10.38
	(52.41)**	[55.37]**	[59.30]**
Observations	121272	100626	100626
R-squared	0.49	0.56	0.58

Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Absolute value of t statistics in parentheses. * Significant at 5%; ** significant at 1%. Dependent variable is years of schooling of children ages 9-15. Ordinary Least Squares regressions used.

Table 6: OLS Using Household Size

	1973	1984	2000
	(1)	(2)	(3)
Household Size	-0.032	-0.071	-0.111
	(10.35)**	[19.03]**	[30.31]**
Age	1.638	1.922	1.520
	(28.70)**	[33.73]**	[35.36]**
Age Squared	-0.042	-0.048	-0.031
	(17.40)**	[20.33]**	[17.33]**
Male	-0.130	-0.218	-0.194
	(7.93)**	[13.25]**	[15.67]**
Mother's Ed	0.207	0.301	0.198
	(11.81)**	[11.92]**	[21.50]**
Father's Ed	0.191	0.168	0.289
	(11.31)**	[19.15]**	[29.89]**
Urban	0.120	0.062	0.060
	(5.59)**	[3.01]**	[4.49]**
Owns Home	0.235	0.235	0.298
	(13.12)**	[12.41]**	[20.22]**
Electricity	0.655	0.504	0.289
	(31.96)**	[21.32]**	[8.15]**
Refrigerator	0.370	0.400	0.482
	(15.47)**	[18.91]**	[22.98]**
Constant	-10.003	-12.292	-10.160
	(29.77)**	[36.47]**	[39.73]**
Observations	29045	27737	44519
R-squared	0.51	0.59	0.62

Source: Integrated Public Use Microdata Series, Costa Rica. Compiled by University of Minnesota and the National Institute of Statistics and Censuses, Costa Rica. Absolute value of t statistics in parentheses. * Significant at 5%; ** significant at 1%. Dependent variable is years of schooling of children ages 9-15. Here, number of people in household, rather than number of children, is used as an independent variable. Ordinary Least Squares regressions used.

Here, the coefficient for adding one additional person to the household has more variation than the siblings variable had, but the overall magnitude stays within the range of the sibling variable. While the coefficient is smaller in 1973 than the coefficient on one additional sibling for children ages 9-15, the coefficient on adding one additional household member in 2000 is approximately equal to adding one additional sibling to the family of a 16 year old. Hence, the measure of siblings and the measure of overall household size, regardless of the individuals'

relationships within the household, capture essentially the same effect. Other control variables in this regression also have similar directions and magnitudes as in the sibling model. The fact that similar results were found when using two separate measures of family size proves that this negative correlation is a robust finding.

In short, OLS regression results presented in these models predict that the negative effect of larger families on education for children ages 9-15 increases over time, judging by the increasing coefficients on number of children from 1973 to 2000. This means that having an additional person in the household in 2000 decreases an individual's years of schooling by a greater magnitude than having an additional child in 1973. The effect of other control variables, such as parents' education on an individual's schooling decreases slightly over time, when using the household size variable as the dependent variable, but increases when using the sibling variable. As the distribution of educational attainment spreads out over time, becoming less concentrated in fewer years of schooling, the possible outcomes become more variable. The changes in the magnitudes of these coefficients account for the increasing diversity of the Costa Rican population over time. Still, the overall effect of household size on education in comparison with other control variables is small. In the end, while these regressions show that there is indeed an effect of adding an additional person to a household on schooling, this effect is small in comparison to a multitude of other factors that influence a household's educational decisions.

VI. CONCLUSIONS

Based on the figures and tables presented in this analysis, it is clear that households in the Costa Rican population have become both smaller and more educated during the past thirty

years. However, a cursory glance at these facts reveal very little about the actual changes in the population that have occurred. While there is a clear negative correlation between the size of a household and the level of schooling of individuals in that household, the direction of the causality is more complicated. In fact, not only do smaller households attain higher levels of education, but urban households, households with more educated parents, and households with electricity also attain higher levels of education. Due to the fact that all of these factors develop simultaneously as a society grows, it is likely that they all play a role in increasing education of the individuals within that society, to some extent.

The ordinary least squares estimates in this analysis reveal that all of these factors do indeed significantly influence the amount of schooling that a child in Costa Rica achieves, including the effect of household size, which is the focus of this analysis. As expected by classical theory, the years of education a child receives decreases as the number of people in that individual's family increases. For 9-15 year olds, adding one additional sibling to a family decreases the years of schooling for that child by between 0.04 and 0.09 years. The effect is slightly larger for 16 year olds, but still remains substantively small. In fact, this effect is smaller in magnitude than the effect of several control variables, for example, increasing mother's schooling by one year. Other significant predictors of educational attainment include household income, which is replicated here by the presence of electricity, a refrigerator, owning a home, living in an urban area, and being female. Despite the fact that the magnitude of the effect of increasing family size is relatively small, this nevertheless settles part of the debate of the causal relationship between household size and educational attainment.

It is difficult to place a magnitude on the opportunity cost of schooling in Costa Rica based on these results. However, the regression estimates here can be understood to mean that

the opportunity cost of schooling is higher for families with more children, and for families whose parents have lower income. As Becker suggests, this could result from a tradeoff between the quantity of children, and the quality, or investment that parents instill in each of their children. The larger negative effect found for older children (age 16) demonstrates the diminishing returns to education for children in large families, especially for boys in large families. As their earnings from labor increase with age, the value of schooling decreases in comparison to these wages. While the actual costs associated with schooling, costs like books, shoes and pencils, may be relatively small, the cost of wages these children could have earned had they not been in school is much higher. This certainly increases as children age and are able to perform more difficult, or valuable, tasks. Additionally, if parents have fewer years of education, they most likely have lower wages, which would make the children's contribution to income even more valuable.

The story is less clear for households with many children. Children's wages could be more highly valued because there are more mouths to feed in the household; or, parents might decide to have more children in order to help support the family. Regardless of whether this decision was made before or after educational decisions, the effect is the same: larger families tend to value children's wages more than smaller families, a fact which increases the opportunity cost of attending school. The OLS results confirm these suppositions, and inform possible changes to a variety of conditional cash transfer programs in Latin America. While a fixed monthly stipend or coupon may encourage a family with one or two children to send their kids to school, the fixed amount of the transfer may not always be enough to overcome the opportunity cost of education for children in large families.

Despite the possible limitations to education that children in larger families face, the data from Costa Rica mainly presents positive changes over time through increased education, and suggest that the country is continuing to grow and attain even higher levels of education. Every generation of children that grows up to be more educated parents can help make informed decisions to serve as a model in the community and throughout the region.

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