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FEMALE EDUCATIONAL ATTAINMENT AND EXPANSION IN LATIN AMERICA: HETEROGENEITY OF THE DIRECT AND INDIRECT EFFECTS ON FERTILITY

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ABSTRACT

Educational attainment of women in Latin America has substantially improved in the past decades. Inversely, fertility has been declining sharply. However, few studies have assessed heterogeneity at the individual, regional, and country level, especially in Latin America. I use all Demographic and Health Surveys (DHS) data for ten Latin American countries between 1986 and 2015. To build on this research gap, I assess the indirect "spillover" and "diminished selectivity" effects, and regional and country variations of this relationship. Preliminary findings suggest that while cross-regional and cross-country variation exists in this relationship between female education and fertility, it gets attenuated by individual level characteristics. Finally, past educational expansion has resulted in heterogeneity at both ends of the education spectrum, producing indirect "spillover" and "diminished selectivity" effects among women with very low and very high levels of education.

INTRODUCTION

Educational attainment of women in Latin America has substantially improved in the past decades (Castro Martin and Juarez 1995). In addition, fertility has been declining sharply. Scholars have explained falling fertility trends through the second stage of the First Demographic Transition experienced by less and least developed countries beginning in the mid-1960s (Lee 2003). By the early 2000s, 60 countries with 43 percent of the world's population had reached fertility at or below the replacement level of 2.1 children per woman; a total number that has continued to increase since then

(Lee 2003). As a result, an extensive literature has focused on examining the negative relationship between female education and fertility (Castro Martin and Juarez 1995; Castro Martin 1995). Despite this extensive literature, few studies have assessed heterogeneity of this relationship at the individual, regional, and country level, especially in Latin America (Castro Martin and Juarez 1995; Miro, Mertens, and Davis 1968). Building on this research gap, I assess the indirect "spillover" and "diminished selectivity" effects, as well as, regional and country variations of this relationship in this region.

Using cross-sectional Demographic and Health Surveys (DHS) data for ten Latin American countries between 1986 and 2015, this paper focuses on the heterogeneity of the direct and indirect effects of educational expansion on fertility in Latin America. First, I examine cross-country and cross-regional variation in female education on fertility. Then, I discuss differences between very educated and less educated women, particularly through empirical evidence of indirect "spillover" and "diminished selectivity" effects on education and fertility.

BACKGROUND

A vast literature exists documenting the negative association between female educational attainment and early sexual initiation, early marriage, and fertility, as well as the mechanisms that determine this relationship (Basu 2002; Cochrane 1979; Caldwell 1980). Mason (1997) provides a rich overview of six fertility transition theories starting with the classic fertility transition theory, which sees fertility decline as a result of changes in social life by industrialization and urbanization (Thompson 1930; Notestein 1953). The second theory builds on the first by adding a shift in social values focused on individualism and self-fulfillment, that occur with rising affluence and secularization, and which lead to declining fertility patterns (Lesthaeghe 1983; Lesthaeghe 1995; Lesthaeghe and Surkyn 1988; Lesthaeghe and Wilson 1986).

Third, Caldwell's (1985) theory of wealth flows explains fertility decline through the emotional nucleation of the family, which makes children, not parents, the net economic beneficiaries of family life through the reversal of intrafamilial "wealth flows" (Mason 1997). Fourth, Becker (1960) and Schultz (1973) explain fertility decisions through the perceived relative costs of childrearing (Szreter 1993: 693). In high-mortality, pre-transitional societies, families might engage in more reproductive behaviors due to the inherent "fatalistic" perception that some of their children will not survive, which shifts as child-survival increases (Montgomery 2000; Lloyd and Ivanov 1988).

The fifth theory explains fertility in terms of the supply of children (the number of children parents would bear in the absence of deliberate fertility limitation), the demand for children (the number of surviving children they would like to have), and the "psychic, social and monetary costs" of fertility (Mason 1997; Easterlin 1975; Easterlin 1978; Easterlin and Crimmins 1985). The final theory presented by Mason (1997) is ideational theory. It builds on previous theories by adding the role of diffusion of information, and new social norms about birth control, to explain the historical and cross-national fertility decline (Bongaarts and Watkins 1996; Kabeer 2001; Mason 1997; Szreter, Nye, and van Poppel 2003).

In addition, the literature on the sociology and economics of education has argued that education has positive externalities for the society because it generates knowledge that has the potential to spill beyond the individual. Specifically, researchers have gained interest in the effect of education on non-market outcomes, such as health, fertility, and social behaviors (Cutler and Lleras-Muney 2008; Black & Devereux 2011; Currie 2009; Kemptner and Marcus 2013). Those that study historical fertility patterns argue that women's decisions about their fertility are often influenced by feedback loops generated by more and less educated women, as well as by women with and without children (Testa 2014; Kravdal and Rindfuss 2008).

Given worldwide demographic changes, researchers have progressively focused on cross-country and cross-regional comparative research to understand how these processes vary and are informed by their contexts (Salway et al. 2011). Cross-country comparative research on education and fertility has varied immensely across areas, ranging from the study of education (Barro and Lee 1993), general fertility (Miro, Mertens, and Davis 1968; Bongaarts 2008; Castro Martin 1995; Castro Martin and Juarez 1995), adult health (Bakhtiari, Olafsdottir, and Beckfield 2018; Behrman 2015; Cutler and Lleras-Muney 2008), child health (Magadi 2011; Bicego and Boerma 1993; Boyle et al. 2006; Desai and Alva 1998), reproductive health and behaviors (Entwisle, Mason, and Hermalin 1986), and health service utilization (Ahmed, Creanga, Gillespie, and Tsui 2010). However, less research has focused on the variation of these processes at the regional level (Torche 2011; Behrman and Weitzman 2016).

RESEARCH QUESTIONS

I ask the following questions:

Regional and Country Variations

1. **Is female educational attainment, and fertility decline, consistent across countries and regions, as opposed to country, and region-specific?**

   Hypothesis 1: The relationship between educational attainment and fertility varies across countries and regions.

Countries and regions that are more developed and richer will experience lower levels of fertility compared to their poorer and rural counterparts. Country and region-specific factors, such as level of development result in maternal education having varying effects on fertility outcomes.

Indirect Spillover and Diminished Selectivity

2. **Why does fertility decrease across survey waves for women with very low education in Latin America?**

Hypothesis 2: Fertility decreases across survey waves for women with very low education in Latin America because of spillover effects.

The increase in female education in these countries has resulted in the dissemination of information, informal education, changing norms, values, and attitudes about reproductive behavior and gender roles through informal channels. Thus, women who remain highly uneducated in later survey waves, yet experience lower fertility, benefitted from the spillover effect of female educational expansion programs.

3. **Why does fertility increase across survey waves for women with very high education in Latin America?**

Hypothesis 3: Fertility increases across survey waves for women with very high education in Latin America because of diminished selectivity effects.

The increase in female education in these countries has resulted in expansion of education to populations that were previously uneducated. Thus, the education-fertility premium decreases with expansionary efforts as women who are highly educated in later survey waves yet experience higher fertility, suffered from the diminished selectivity of female educational expansion programs.

SUPPORTING DATA

This analysis uses pooled cross-sectional DHS data from ten Latin American countries (Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Peru). The DHS is a publicly available nationally representative survey of women ages 15-49 collected by ICF International in collaboration with host country governments. The standardized questionnaires across countries allow for easy cross-country comparisons for a wide range of socioeconomic and demographic indicators in the areas of population, health, and nutrition. Data came from all available survey waves for ten Latin American countries (Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Peru). The DHS waves included were the following: Brazil 1986, 1991, and 1996; Ecuador 1987; El Salvador 1985; Honduras 2005-2006 and 2011-2012; Mexico 1987; Nicaragua 1998 and 2001; Peru 2010, 2011, 2012, 2013, and 2014. Description of the variables used in the analysis (variable names and definitions) can be found in Appendix 1.

Outcome Variable: Total Children Ever Born

The outcome of interest in this study is total children ever born. I have recoded this variable into an ordered integer scale from 1 to 16, varying slightly by country, where 1 indicates one child and 16+ indicates sixteen and more children. This variable will be used to determine the effect of women's education on number of children ever born, for women in each country, and during the survey years. The description of the dependent variable and the coding used in the analysis is given in Appendix 1.

Other Explanatory Variables: Women's Education, Cognitive, Socioeconomic, and Normative Variables

I controlled for a number of other factors that potentially confound the relationship between my independent and dependent variables of interest, by adding them to subsequent models. The main independent variable of concern is women's education, recoded from single years to educational categories: 0 years, 1-3 years, 4-6 years, 7-9 years, and ≥10 years.

In addition, I explore three key dimensions of education and their implications for the fertility behavior of women in Latin America. First, for education as a source of knowledge (Reed et al. 1999), I operationalize by controlling for those women who listen to the radio daily, know their source of contraception, and understand their ovulatory cycle. Second, for education as a vehicle of socioeconomic advancement (Becker 1962), I operationalize by controlling for husband's mean years of education and women who live in an urban area and own a refrigerator.

Finally, for education as a transformer of attitudes and adoption of new norms and values (Caldwell 1976; Caldwell 1980), I operationalize by controlling for women who are not using contraception, mean parity at first contraceptive use, mean age at first marriage, being in a legal union, having had a premarital birth, having had their first birth before the age of 18, worked before marriage, kept their wages, and worked after marriage. The description of the independent variables and the coding used in the analysis is given in Appendix 1.

ANALYSIS PLANS

Regional and Country Variations

In the first part of this paper, I test for Hypothesis 1 by exploring cross-regional and cross-country variation of the relationship between female education and fertility in Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Peru. To reduce the computational power required to conduct preliminary analysis at the preliminary analysis stage, I ran multilevel Poisson regression models using a 10% random sample of my population (*n*=138,517). I am proposing to use multilevel models to test Hypothesis 1 because this methodology provides conceptual and methodological advantages that both traditional linear and nonlinear models cannot address. For instance, multilevel models provide a way to study multilevel data, particularly, how the macro-context affects the impact of a covariate at the micro-level (Guo and Zhao 2000). Methodologists have also addressed the advantages of multilevel models in correcting for biases in parameter estimates resulting from clustering, correcting for standard errors and corresponding confidence intervals and significance tests, and estimating variance and covariance of random effects at various levels (Guo and Zhao 2000; Pebley, Goldman, and Rodriguez 1996). I also propose to use a Poisson model as the most optimal specification because the dependent variable of this paper, number of children ever born, is a count variable, which violates assumptions of normality in standard regression techniques (Crosnoe, Cavanagh, and Elder 2003).

For this paper, I studied the relationship between female education and fertility at the individual, regional, and country level. I used a two-level multilevel approach to study fertility, where individual women units (level 1) are nested within country units (level 2). In the first level, individual characteristics have effects on variations in women's education on fertility. At the second level, country characteristics are predicted to have independent effects as well as to moderate the effects of women's education on fertility. Since I also expect variation between regions, particularly how regional characteristics affect women's education on fertility, I include a cross-level interaction between region indicators and women's education. At the regional level, I assess for variation based on the economic development of the region. To compare rich and urban regions to poor and rural regions, I construct a dichotomous variable using regional GDP data to do so. The sample for the first level includes 138,517 observations and the sample for the second level includes 10 observations. The final version of the analysis will include all 1,407,986 individuals from 118 regions and from the 10 countries. Expanding the data to include the full sample will increase the sample size, particularly at the regional level, to yield unbiased estimates of the second-level standard errors (Maas and Hox 2005).

The dependent variable of the multi-level Poisson regression model is the number of children ever born to women in Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Peru between 1985 and 2015. I control for family socioeconomic characteristics and norms, values, and behaviors at the individual level. More specifically, the multilevel models provide estimates of variance in the outcome variable that are due to unobserved country factors, generally known as the random effect (Bingenheimer and Raudenbush 2004). Accordingly, all models will include a random intercept at the country level and a random coefficient for women's education to capture heterogeneity among clusters. Equation 1 presents the two-level combined model used.

Eq. (1)

$$\ln[\lambda ij] = \gamma 00 + \beta_1 x_{ij} \cdots \beta_k X_k + u0j$$

Where yij is the observed number of count number of children ever born to women i in country j, and, λij the expected number given a model: $E(y_{ij})$. In addition, x_{ij} is an explanatory variable at the individual woman level and u_j is the random effect at level two. Table 1 reports the multilevel results of the outcome.

Indirect Spillover and Diminished Selectivity Effects

In the second and third part of this paper, I test for Hypotheses 2 and 3 to assess differences at both ends of the education spectrum, between very educated and less educated women. I am particularly interested in indirect spillover and diminished selectivity effects affecting the fertility outcomes of women with low levels *and* high levels of education in Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Peru. I test for the decrease in fertility of women *with zero years and very little education*, which I describe as a result of spillover effects, through indirect reproductive behavior variables. These variables listed below will measure reproductive knowledge and gender behaviors, which are supposed to be gained from informal sources from exposures to women with more education and living in a more educated society in general.[1] [2]

The variables include: knowing their source of contraception, not using contraception, understanding their ovulatory cycle, listening to the radio daily, mean parity at first contraceptive use, mean age at first marriage, had premarital birth, and had first birth before the age of 18. I will conduct a similar analysis to test for the increase in fertility of women *with ten and more years and very high education*, which I describe as a result of diminished selectivity effects. First, I will use variables that measure direct increases in total female education over time to determine whether expansionary educational efforts may have decreased the education-fertility premium among the highly educated. Second, I will use direct and indirect measures of labor force participation and household wealth among very educated groups, to determine whether highly educated women have increasingly stayed at home in more traditional gendered and reproductive roles.

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[1] Although the DHS collects certain *direct* measures of informal dissemination of information (whether women with very little education received information on sexuality, contraception, pregnancy, anatomy of sexual organs, abortion, and STDs/AIDS through other "informal channels," the data is inconsistent and sparse, and therefore not considered for this analysis.

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PRELIMINARY RESULTS

Regional and Country Variations

Preliminary findings from bar graphs for Latin American countries, show heterogeneous trends for women in more rich and less rich regions, as well as differences between countries. I argue that these trends may suggest that some Latin American countries, and some regions within countries, are experiencing earlier stages of the First Demographic Transition, perhaps, as a result of economic development and wealth (Caldwell 1976; Lee 2003).

[Figure 15-17 Here]

Preliminary findings from the two-level Poisson model in Table 1 suggest that there is some partial support for Hypothesis 1, which predicts that regions and countries that are more developed and rich will have experienced lower levels of fertility than their poorer and rural counterparts. As it pertains to regional variation, Model 1 and Model 2 suggest that living in a region that is rich and developed, relative to living in a region that is poor and underdeveloped, multiplies the odds of having one additional child by 0.976 and 0.965 (p-value<0.000) respectively, holding the other variables in the model constant. In support of Hypotheses 4 and 5, these results lose significance with the introduction of norms, values, and behaviors about reproduction, marriage, and work at the individual level, regardless of educational attainment. The same is true for the interaction between region and female educational attainment, which loses significance with the introduction of socioeconomic characteristics, norms, values, and behaviors about reproduction, marriage, and work at the individual level.

Table 1 also shows that there is statistically significant variance in country level fertility. The estimated variance of the country level intercepts for Model 1 is 0.111 and is statistically significant (p-value<0.000), for Model 2 is 0.066 and is statistically significant (p-value<0.000), and for Model 3 is 0.043 and is statistically significant (p-value<0.000). The same is true for the estimated variance of the slope of women's education across countries. However, this variance is small and to an extent not meaningful, which suggests that the relationship between female education and fertility in these ten Latin American countries is very similar. Table 1 reports the multilevel Poisson regression results of the three nested models.

[Table 1 Here]

Indirect Spillover and Diminished Selectivity Effects

Preliminary findings from overlaid best fit lines for the ten Latin American countries in early, middle, and later survey waves show different trends for educational groups; essentially, the slope of the best fit line declines over time with a decrease in fertility among those with low levels of education and an increase among those with high levels of education. I argue that these trends may suggest two phenomena at both ends of the education spectrum. First, for women with low levels of education, the decrease in fertility may be a result of spillover effects. That is, women with low levels of education throughout survey waves may have experienced changes in their fertility behavior, as well as changes in reproductive norms and values, gained from informal sources from exposures to women with more education and living in a more educated society in general. On the other hand, for women with high levels of education, the increase in fertility may be a result of diminished selectivity effects. That is, while women with high levels of education throughout survey waves may not necessarily have experienced changes in actual fertility, the universal expansion of female education in these countries has resulted in a decrease in the education-fertility premium enjoyed by educated women in previous decades.

[Figure 1-8 Here]

I ran preliminary cross-tabs and constructed proportions for women with zero and very little education in Guatemala, Colombia, and Bolivia. My cross-tabs suggest that there has been a decrease in the number of women in these less educated groups (zero years of education) in Colombia over time (representing 15% in 1986, 9% in 1995, and 7% in 2005). On one hand, this points to the diminished selectivity effect of more women attending school, since the number of women in these lower educational groups has been decreasing over time. Then, I compared the proportions across survey waves to determine whether less educated women have been exposed, increasingly, to spillover information that may have influenced their fertility across time. Specifically, I looked at the variable "understanding ovulatory cycle."

[Table 2 Here]

My cross-tabs and proportions suggest that women with zero and very little education have an increasing understanding of their ovulatory cycle. When asked about their understanding of their ovulatory cycle, respondents could answer: during my period, after period ended, middle of the cycle, before period begins, at any time, other, and don't know. To accurately represent their understanding, I dichotomized this variable from the original categories to reflect the accurate answer of a regular ovulatory cycle (Wilcox, Dunson, and Baird 2000). Even though women with zero years of education in Colombia in 1986 did not received formal education, like women with zero years of education in

1990, 1995 and 2000, the proportion of women with zero years of education with an understanding of their ovulatory cycle increased over time (representing 8.06% in 1986, 10.11% in 1995, 13.29% in 1995, and 19.03% in 2000). I find similar patterns for Guatemala and Bolivia. Interestingly, although there is heterogeneity among countries in terms of the slope of this line, this spillover effect seems to have a threshold across these three countries. For Colombia, the effect reverses in 2000, for Guatemala, the effect is steadier but seems to slowly decrease after 2015, and for Bolivia, the effect reverses between 1995 and 2000. These findings are largely consistent with Hypothesis 2, which predicts that fertility decreases across survey waves for women with very low education because of spillover effects from educational expansion initiatives in the region.

[Figure 9-14 Here]

FUTURE DIRECTION

This preliminary analysis provides an important step in unpacking the relationship between educational attainment and fertility behavior for women in Latin American countries. I plan to extend this work in the future in several ways. First, I will test for Hypothesis 1 by conducting a two-level multilevel approach to study fertility where individual women units (level 1) are nested within regional units (level 2), instead of country units (Table 1). In addition, I will use the full sample, containing all ten countries and a total of 1,407,986 observations. Finally, I plan to systematically test for Hypotheses 2 and 3, particularly, the diminished selectivity effect among highly educated women, to explore historical educational and fertility differences between more educated and less educated women, across regions and countries.

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APPENDIX 1

Table 1: Results of Multilevel Poisson Model with Individual, Regional, and Country Predictors for the Odds of the Number of Children Ever Born to Women in 10 Latin American Countries, by Country (Demographic and Health Surveys 1986-2015)

	Model 1				**Model 2**				**Model 3**			
	Odds Ratio		95% C.I. Low	95% C.I. High	Odds Ratio		95% C.I. Low	95% C.I. High	Odds Ratio		95% C.I. Low	95% C.I. High
Region (ref.=poor)	**0.976**	***	0.967	0.986	**0.965**	***	0.951	0.979	0.990		0.955	1.026
	(0.005)				(0.007)				(0.018)			
Mother's education in single years	**0.927**	***	0.923	0.932	**0.939**	***	0.931	0.947	**0.956**	***	0.945	0.966
	(0.002)				(0.004)				(0.006)			
Region X Mother's education in single years	**0.996**	***	0.995	0.998	0.998		0.995	1.001	1.002		0.995	1.009
	(0.001)				(0.001)				(0.004)			
Survey Year	**0.995**	***	0.995	0.995	**0.995**	***	0.995	0.996	**0.992**	*	0.985	0.999
	(0.000)				(0.000)				(0.004)			
Socioeconomic Status												
Husband's education in single years					**0.998**	***	0.998	0.998	**0.998**	***	0.997	0.999
	0.953				(0.000)				(0.001)			
Type of residence (ref.=rural)					**0.925**	***	0.916	0.933	0.982		0.955	1.009
					(0.005)				(0.014)			
Refrigerator (ref.=doesn't have)					**0.936**	***	0.929	0.944	**0.948**	**	0.917	0.979
					(0.004)				(0.017)			
Listens to the radio daily (ref.=doesn't listen)									**0.966**	**	0.943	0.990
									(0.012)			
Attitudes												
Not using contraception (ref.=using contraception)									**0.950**	***	0.924	0.976
									(0.014)			
Parity at 1st contraceptive use									**1.087**	***	1.077	1.097
									(0.005)			
Family Formation Paths												
Age at first marriage									**0.978**	***	0.974	0.981
									(0.002)			
Currently or previously in legal union (ref.=not)									**1.141**	***	1.112	1.171
									(0.013)			
Had premarital birth (ref.=did not)									**1.000**	***	1.000	1.000
									(0.000)			
Had first birth < 18 years (ref.=did not)									**1.069**	***	1.039	1.101
									(0.015)			
Working Paths												
Worked in last 12 months (ref.=did not)									1.000			
									(.)			
Works away from home (ref.=at home)									0.987		0.962	1.012
									(0.013)			
Earns cash for work (ref.=does not)									0.975		0.946	1.005
									(0.015)			
Constant	1.25E+05	***	66844.365	2.35E+05	77321.637	***	26563.786	2.25E+05	4.17E+07	*	45.756	3.81E+13
	(0.320)				(0.545)				(7.002)			
Random-effects Parameters												
country												
sd(women's education in single years)	0.007	***	0.004	0.011	0.007	***	0.003	0.017	0.009	***	0.004	0.022
	(0.255)				(0.417)				(0.463)			
sd(constant)	0.111	***	0.069	0.179	0.066	***	0.03	0.148	0.043	***	0.017	0.107
	(0.243)				(0.411)				(0.463)			
N	138517				48464				5632			
chi2	2074.503				1461.471				1067.539			

Notes: * p<0.05, ** p<0.01, *** p<0.001

Table 2: Proportion of women with zero and 1-3 years of education who understand their ovulatory cycle by country and year (Demographic and Health Surveys 1986-2015)

Country	Year of DHS	Understands Ovulatory Cycle (%)		Total Population	
Years of Education		**0**	**1-3**	**0**	**1-3**
Guatemala	1987	4.00	7.82	8472	3505
	1995	2.67	6.38	21870	9661
	1998	4.61	9.81	9473	5056
	2014	13.15	17.20	17100	15443
Colombia					
	1986	8.06	17.25	1775	4590
	1990	10.11	16.78	1316	4249
	1995	13.29	24.12	2024	5907
	2000	19.03	26.90	1781	4888
	2005	13.85	19.05	5299	12906
	2010	11.77	17.68	5252	16361
	2015	8.28	16.24	3274	8678
Bolivia					
	1989	9.74	18.92	6116	6434
	1994	80.51	73.06	672	1288
	1998	13.31	25.37	5787	7824
	2003	14.59	22.47	6379	11769
	2008	15.53	27.52	4457	10105

FIGURES 1

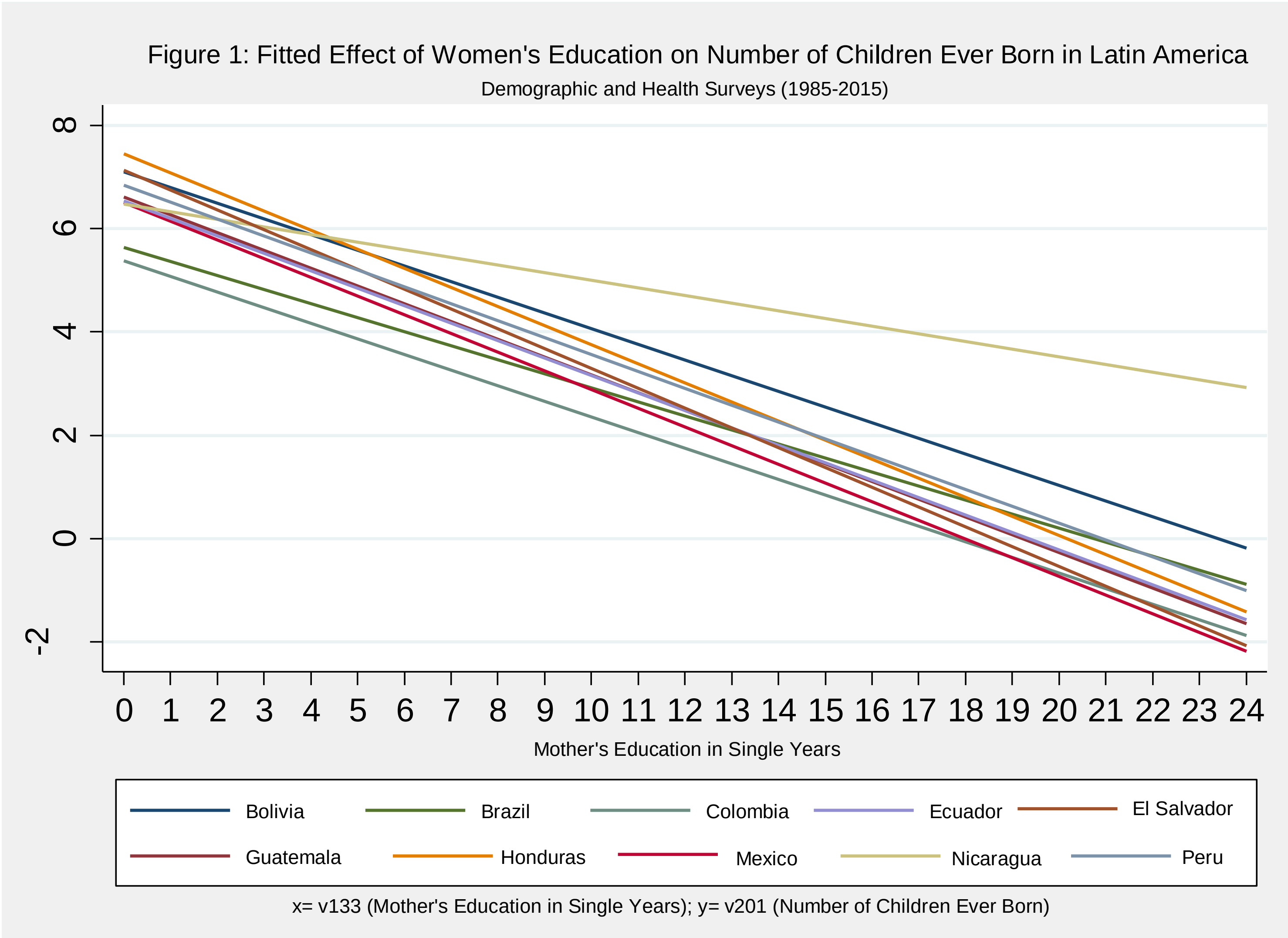


Figure 1: Fitted Effect of Women's Education on Number of Children Ever Born in Latin America
Demographic and Health Surveys (1985-2015)
8
6
4
2
0
-2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Mother's Education in Single Years
Bolivia
Brazil
Colombia
Ecuador
El Salvador
Guatemala
Honduras
Mexico
Nicaragua
Peru
x= v133 (Mother's Education in Single Years); y= v201 (Number of Children Ever Born)

Figure 2: Fitted Effect of Women's Education on Number of Children Ever Born in Bolivia (1989, 1998 & 2008)

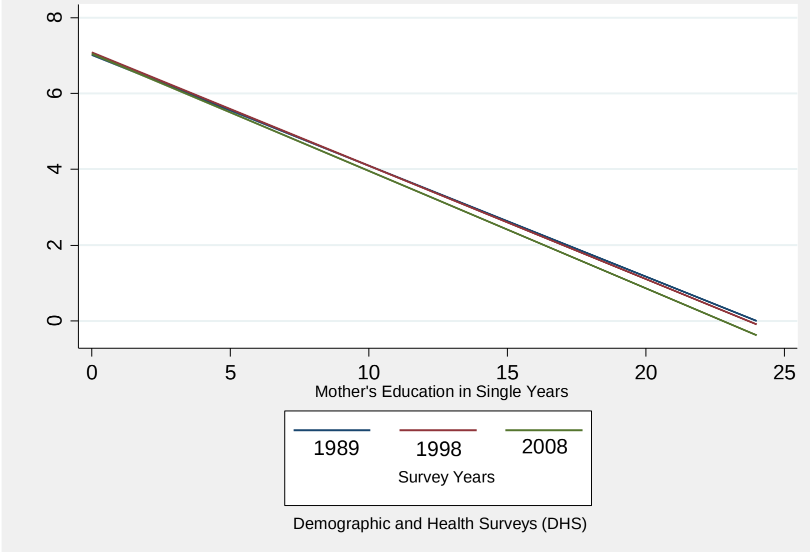


Figure 3: Fitted Effect of Women's Education on Number of Children Ever Born in Brazil (1986, 1991 & 1996)

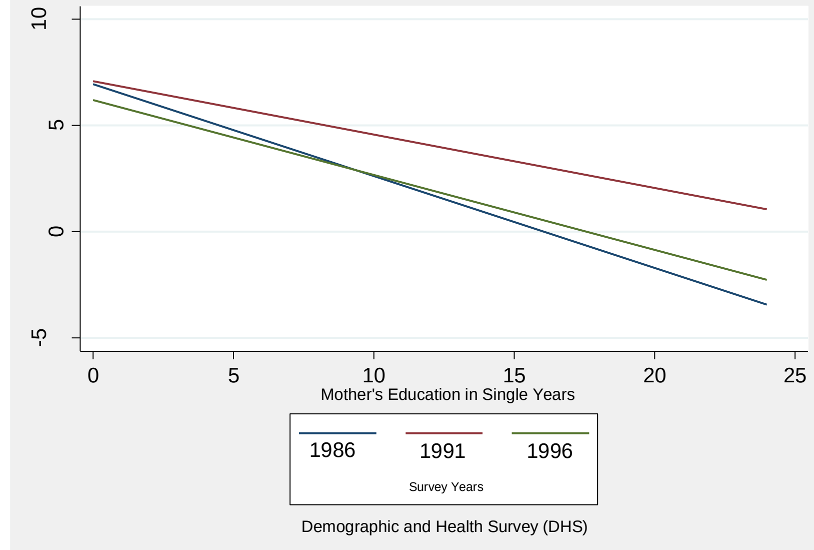


Figure 4: Fitted Effect of Women's Education on Number of Children Ever Born in Colombia (1986, 2000 & 2015)

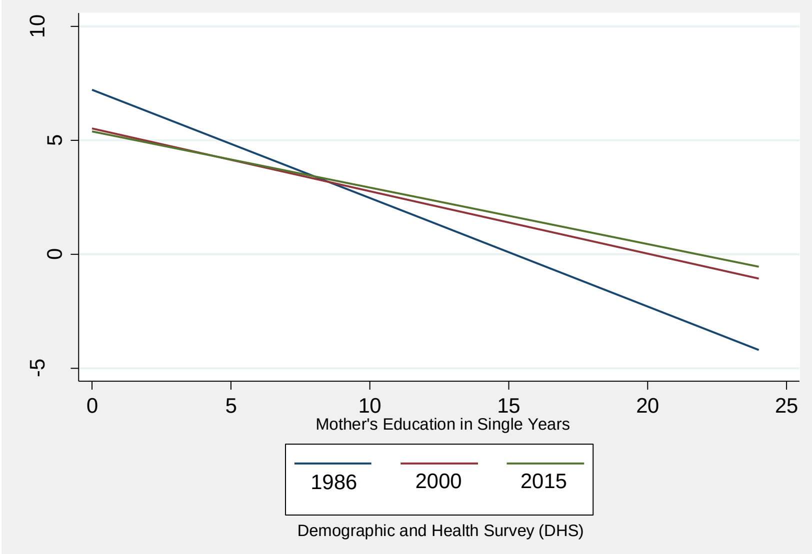


Figure 5: Fitted Effect of Women's Education on Number of Children Ever Born in Guatemala (1987, 1995 & 2014)

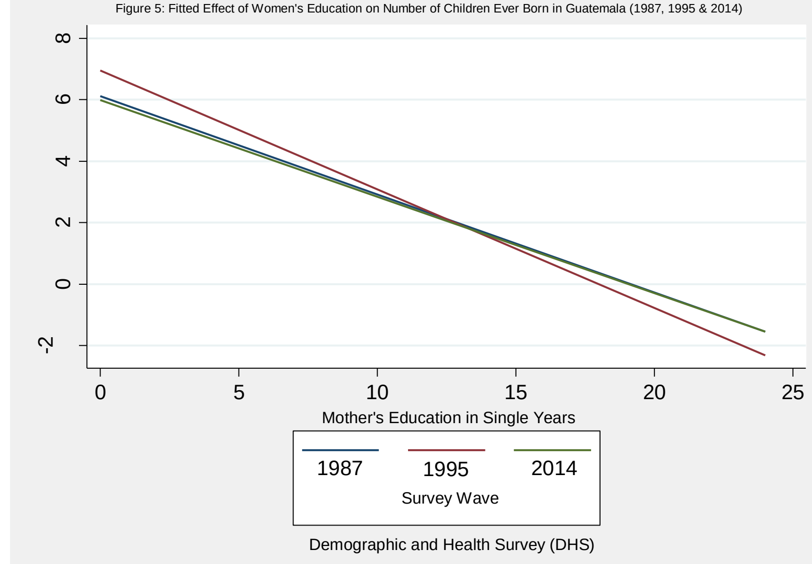
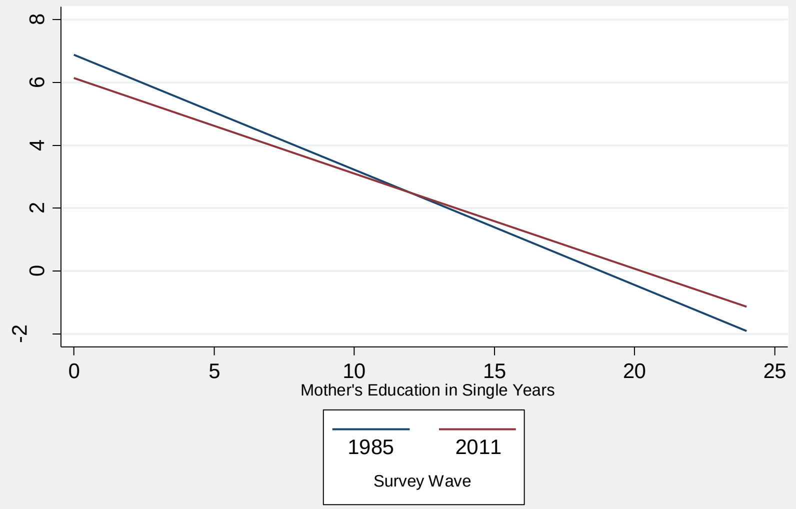
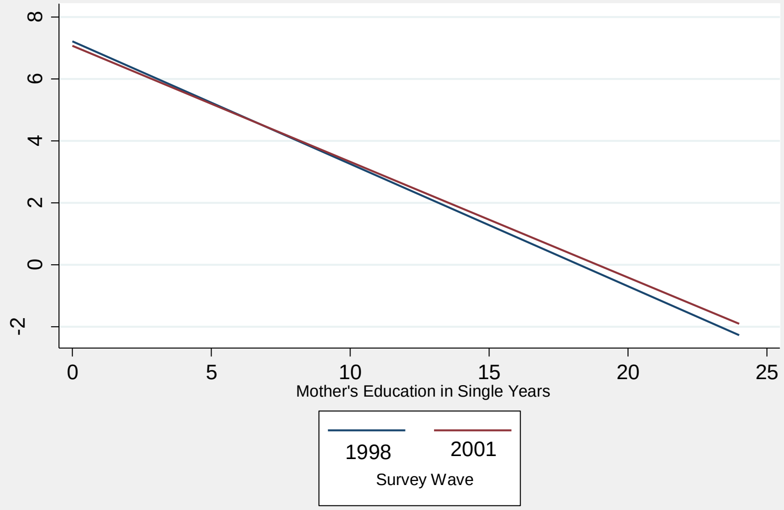


Figure 6: Fitted Effect of Women's Education on Number of Children Ever Born in Honduras (1985 & 2011)



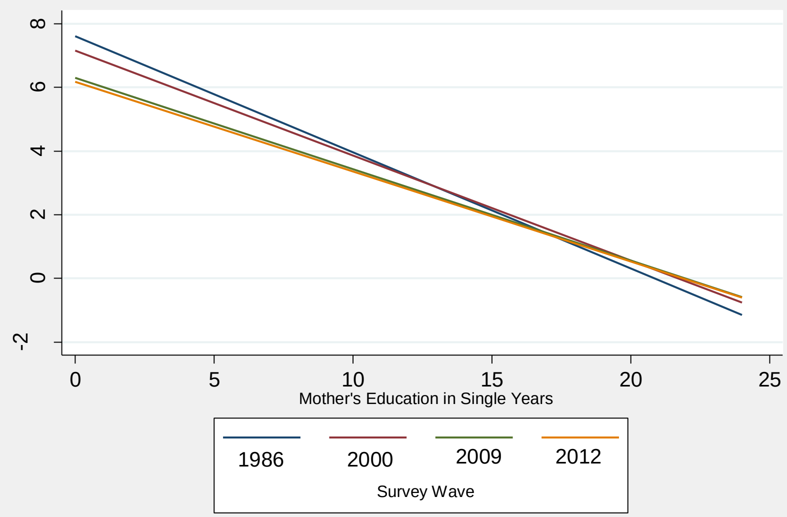
Demographic and Health Survey (DHS)

Figure 7: Fitted Effect of Women's Education on Number of Children Ever Born in Nicaragua (1998 & 2001)



Demographic and Health Survey (DHS)

Figure 8: Fitted Effect of Women's Education on Number of Children Ever Born in Peru (1986, 2000, 2009 & 2012)



Demographic and Health Survey (DHS)

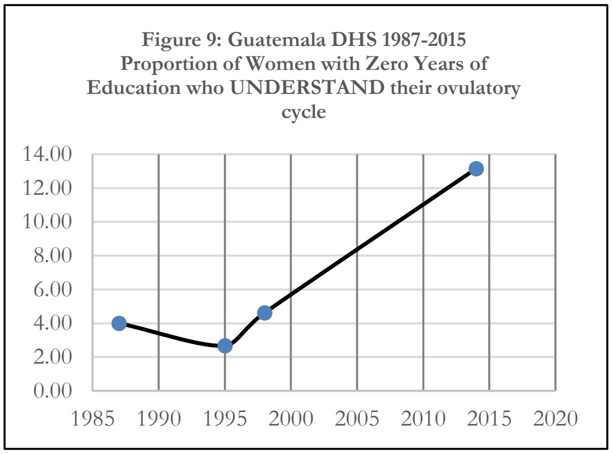


Figure 9: Guatemala DHS 1987-2015
Proportion of Women with Zero Years of Education who UNDERSTAND their ovulatory cycle
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1985
1990
1995
2000
2005
2010
2015
2020

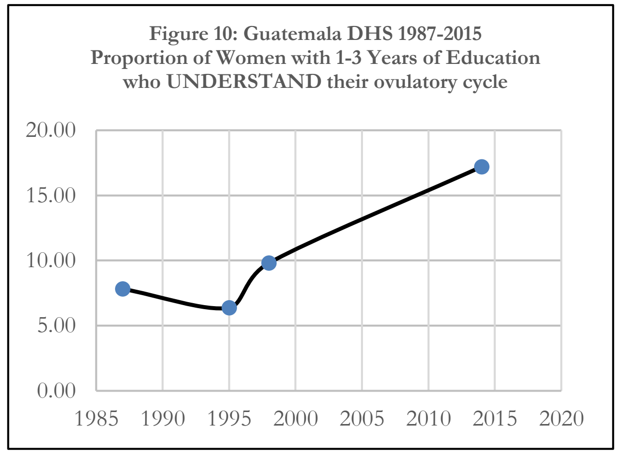


Figure 10: Guatemala DHS 1987-2015
Proportion of Women with 1-3 Years of Education who UNDERSTAND their ovulatory cycle
20.00
15.00
10.00
5.00
0.00
1985
1990
1995
2000
2005
2010
2015
2020

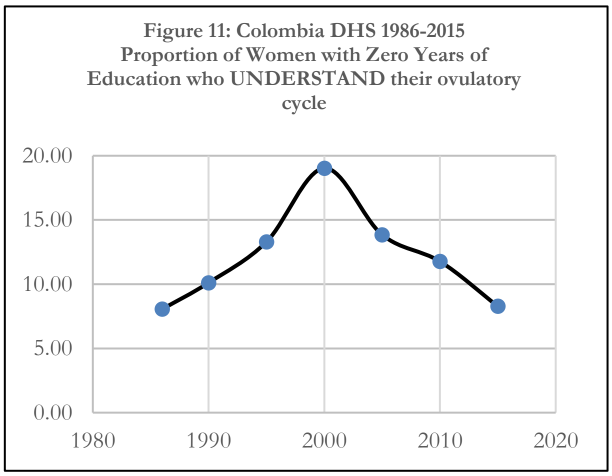


Figure 11: Colombia DHS 1986-2015
Proportion of Women with Zero Years of Education who UNDERSTAND their ovulatory cycle
20.00
15.00
10.00
5.00
0.00
1980
1990
2000
2010
2020

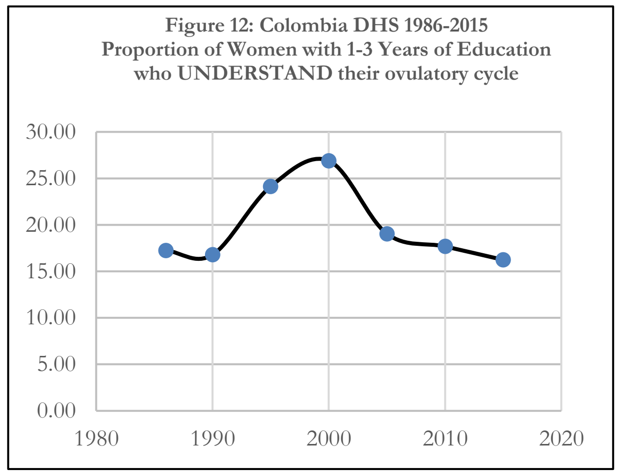


Figure 12: Colombia DHS 1986-2015
Proportion of Women with 1-3 Years of Education who UNDERSTAND their ovulatory cycle
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1980
1990
2000
2010
2020

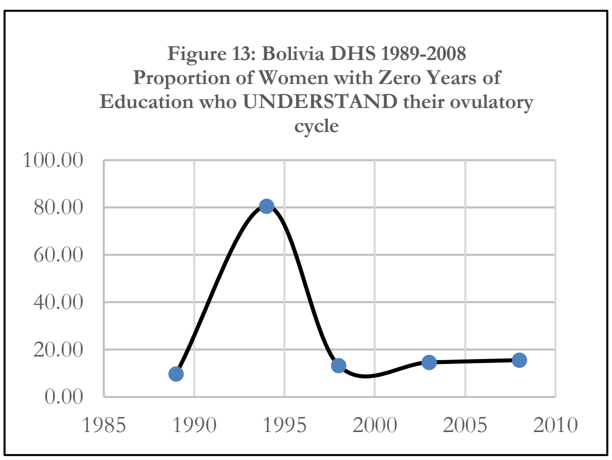


Figure 13: Bolivia DHS 1989-2008
Proportion of Women with Zero Years of Education who UNDERSTAND their ovulatory cycle
100.00
80.00
60.00
40.00
20.00
0.00
1985
1990
1995
2000
2005
2010

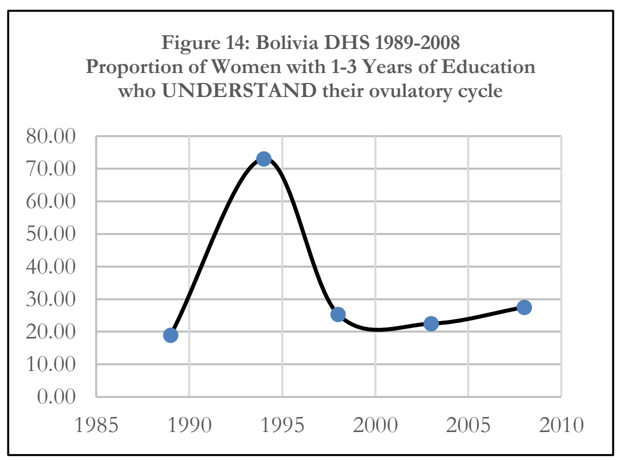


Figure 14: Bolivia DHS 1989-2008
Proportion of Women with 1-3 Years of Education who UNDERSTAND their ovulatory cycle
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1985
1990
1995
2000
2005
2010

Figure 15: Total Number of Children Ever Born in Brazil by Region and Mother's Education
DHS 1986-1996

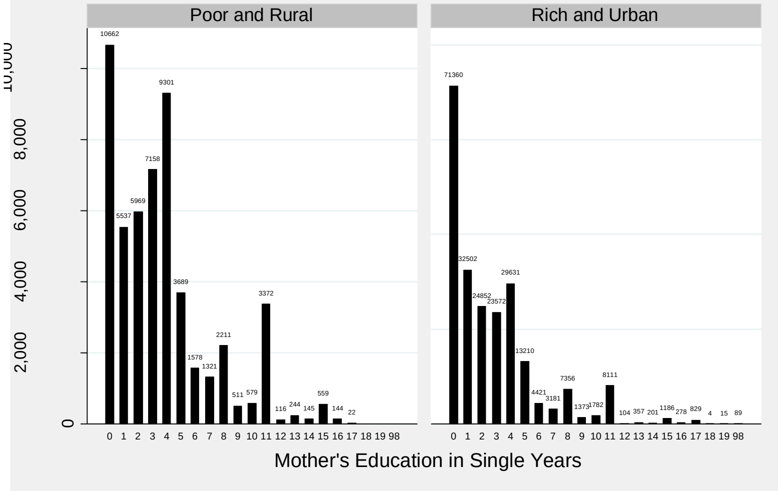


Figure 16: Total Number of Children Born in Colombia by Region and Mother's Education
DHS 1986-2015

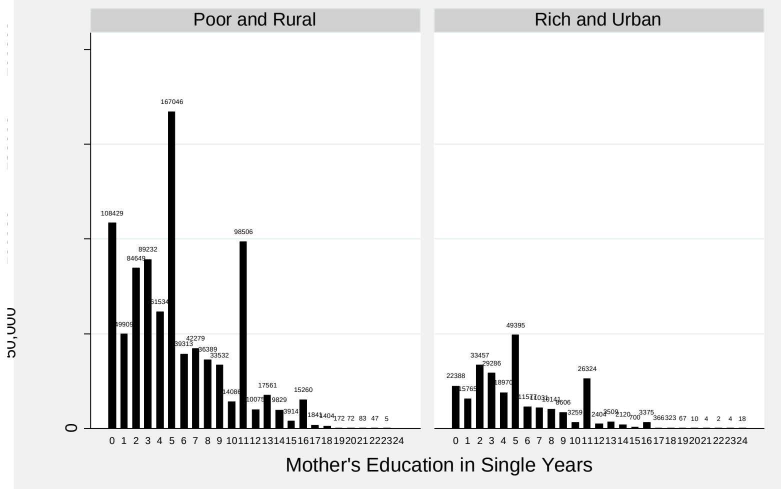
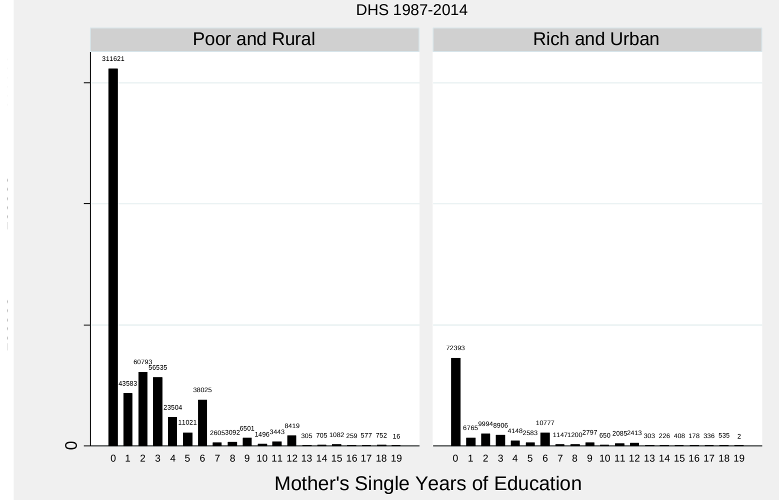


Figure 17: Number of Children Ever Born in Guatemala by Region and Mother's Education
DHS 1987-2014



ANNEX 1: DESCRIPTION OF VARIABLES USED IN THE ANALYSIS

Variable	Description
Dependent Variable	
Total children ever born	Coded as: (1="1"; 2="2"; 3="3"; 4="4"; 5="5"; 6="6"; 7="7"; 8="8"; 9="9"; 10="10"; 11="11"; 12="12"; 13="13"; 14="14"; 15="15"; 16="16")
Independent Variable: Education	
Years of Schooling	Coded as: (0="0"; 1="1-3"; 2="4-6"; 3=">10")
Independent Variables: Cognitive	
Listens to the radio daily	Coded as: (1="yes"; 0="no")
Knows source of contraception	Coded as: (1="yes"; 0="no")
Understands ovulatory cycle	Coded as: (1="yes"; 0="no")
Independent Variables: Socioeconomic Status	
Husband's years of education	Coded as continuous: (0-23="0"-"23")
Lives in urban areas	Coded as: (1="yes"; 0="no")
Household has refrigerator	Coded as: (1="yes"; 0="no")
Independent Variables: Normative	
Not using contraception	Coded as: (1="yes"; 0="no")
Parity at 1st contraceptive use	Coded as continuous: (0="0"; 1="1"; 2="2"; 3="3"; 4="4+")
Age at first marriage	Coded as continuous: (7-47="7"-"47")
Currently or previously in legal union	Coded as: (1="yes"; 0="no")
Had premarital birth	Coded as: (1="yes"; 0="no")
Had first birth < 18 years	Coded as: (1="yes"; 0="no")
Worked in last 12 months	Coded as: (1="yes"; 0="no")
Works away from home	Coded as: (1="yes"; 0="no")
Earns cash for work	Coded as: (1="yes"; 0="no")
Multilevel Variables: Contextual	
Region	Coded as continuous: (Bolivia 1-9; Brazil 10-26; Colombia 27-32; Ecuador 33-38; El Salvador 39-41; Guatemala 42-47; Honduras 48-65; Mexico 66-74; Nicaragua 75-91; and Peru 92-117)
Country	Coded as continuous: (1=" Bolivia"; 2="Brazil"; 3="Colombia"; 4="Ecuador"; 5="El Salvador"; 6="Guatemala"; 7="Honduras"; 8="Mexico"; 9="Nicaragua"; 10="Peru")