Can Education Reduce Teenage Pregnancy? Evidence from Latin America and the Caribbean

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Abstract

PRELIMINARY DRAFT. DO NOT QUOTE OR CIRCULATE WITHOUT PERMISSION OF THE AUTHORS. Teenage pregnancy and childbearing are generally associated with worse labor market and educational outcomes for the mothers. While there is a growing body of literature that studies the effect of several policies on teenage pregnancy in developed countries, literature is scarce in developing countries, specifically for Latin American and the Caribbean. Education attainment often appears as one of the key factors that may contribute to the reduction of teenage pregnancies. Measuring such causal effect, if it exists, is a difficult task due to the endogeneity of schooling decisions. We develop a theoretical model that yields predictions on the effect of education on teenage, non-teenage motherhood, optimal timing of the first born and the number of children. We then test the model using a unique database comprising surveys for 22 countries of LAC countries that use information for cohorts that were born after 1965. We explore regional variations in the number of compulsory years of education as an instrument for education attainment and find no effect of education attainment on teenage motherhood, but we do find a strong significant reduction in non-teenage motherhood.

1 Introduction

Teenage pregnancy and childbearing are believed to be associated with worse labor market and schooling outcomes for mothers (Kearney, 2010). Moreover, even though teenage mother outcomes may not be too adversely affected (Lang and Ashcraft, 2006) health and socioeconomic conditions[1] for their children can be adverse relative to children born from non-teenage parents (Paniagua and Walker, 2012). Importantly, several Latin American and the Caribbean (LAC) countries are increasingly targeting policies to reduce teenage pregnancies due to these adverse outcomes. While there is a growing body of literature that studies the effects of several policies on teenage pregnancy in developed countries, the corresponding literature for developing countries are quite scarce, especially for LAC. This region has one of the highest teenage pregnancy rates of the world (World Bank 2012) above levels observed for developed countries. Yet, in spite of the recent increase in policy evaluations and social programs throughout the region, little is known about what can reduce teenage pregnancy.

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[1] Lang and Ashcraft (2006) show evidence that teenage childbearing has mild effects on mother outcomes for the United States.

Florez and Nuñez (2001) conducted a survey for selected countries in Latin America like Bolivia, Brazil, Colombia, Guatemala, Dominican Republic and Peru using cross sectional data from the Demographic Health Survey (DHS). They point out that in spite of the fertility transition observed in Latin America, teenage fertility has not been reduced by the same amount. They find that teenage pregnancy rates have reduced in urban sectors but have increased or remained constant in rural areas. The Word Bank Report on teenage pregnancy (2012) used several sources in order to characterize the evolution of teenage pregnancy rates and childbearing in LAC countries. As a general trend, teenage pregnancy rates have decreased during the past two decades but the decline has not been as fast as the reduction in fertility rates observed as a consequence of the demographic transition. Actually teenage childbearing has increased in most of the countries in LAC.

The literature on the relation between teenage pregnancy and schooling is also scarce for LAC countries. Nonetheless, there are two recent studies Acevedo et al. (2010) for Colombia and Berthelon and Kruger (2011) for Chile. For the former the authors do not find a significant effect of school programs on teenage pregnancy while for the latter the authors find a 3% decrease in teenage motherhood as a result of expanding the number of hours at school. Education often appears as one of the key factors that may contribute to the reduction of teenage pregnancies. Measuring such causal effect, if exists, is a difficult task due to the endogeneity of schooling decisions. Observational data shows a clear correlation between low levels of education and teenage childbearing but to draw a causal relationship from an increase in education as number of years to a decrease in teenage fertility rates requires an additional source of exogeneity due to the fact that human capital accumulation and reproductive decisions are either joint decisions or are both affected by unobservables.

We develop a theoretical model that yields predictions on the effect of education on teenage, non-teenage motherhood, optimal timing of the first birth and the number of children. The model predicts that a compulsory education reform would reduce the fraction of mothers in the economy, and would weakly reduce the fraction of teengage mothers in the economy while most probably would (weakly) increase the fraction of adult mothers if investment returns to education are sufficently large to overcome the decrease in the desired number of children that comes with being an educated adult mother. We then test the model using a unique database comprising surveys for 22 countries of LAC countries. We use surveys available since the 1980s and are able to track back cohorts born after 1965. We explore regional variations in the number of compulsory years of education associated with educational reforms as an instrument for schooling decisions. This strategy is not new since the literature has addressed this issue by using exogenous changes in compulsory schooling laws. For example, Black et al. (2008) use variation in compulsory schooling laws for the United States and Norway and finds a modest reduction in teenage fertility rate for both countries. Silles (2011) uses a similar identification strategy for England and Northern Ireland and finds a similar modest effect. The author shows that the education effect in magnitude is greater than the reduction that was observed in the late 1960's due to the availability of contraceptive methods.

There are several reasons as to why one might expect different effects from compulsory education reforms

on teenage pregnancy in developing vs.developed countries. First, it may be that teenagers in developed countries are more aware of contraception methods, second, more time to go to school (both in years and in hours per day) in developed countries may have an "incapacitation effect" similar to the one present in the crime literature. Third, and more importantly, education may enhance labor market perspectives by increasing the economic returns to study and delaying the time to enter the labor market. Developing countries are characterized by a poor quality of education, which may neutralize all the effects mentioned above. Moreover, average years of education is lower in LAC countries than in developed countries, so it might be that compulsory changes in schooling might not be binding for some countries in the sense that teenagers drop out of school well before the time in which they can get pregnant.

If education changes the economic incentives to delay motherhood, mainly via increasing wages in the labor market, then we should expect a decrease in teenage pregnancy. In the context of highly segmented labor market or schooling systems (as it might be the case in some of LAC countries), it may be the case that the expected returns from schooling are very low, and hence, increasing the number of years of compulsory education is not reflected in lower teenage pregnancy rate.

The contribution of our research is threefold. First, we develop a model in order to account for the optimal timing of initial childbearing in the presence of education compulsory reforms. Second, we test the theoretical predictions of such model using data for developing countries using a comprehensive database representative of 22 LAC countries that has never been used to study this issue.

Empirically we find no effect of compulsory schooling reforms and education attainment on teenage motherhood, but do find strong statistical evidence of a reduction in adult motherhood and an increase in non-motherhood in general in countries that did implement education reforms relative to the ones that did not. It is found that the reforms had a positive and significant effect on the proportion of women who completed their secondary education and may had some tertiary education. Countries that implemented such educational reforms increased on average the proportion of women that have complete secondary and some tertiary schooling in 0.08 standard deviations. Moreover, we find using compulsory education reforms as an instrumental variable of education attainmente that as the proportion of women who attain incomplete secondary education increases in one standard deviation the proportion of adult women who become mothers increase by one standard deviation. Furthermore, the opposite effect is found for the proportion of women with complete secondary and some tertiary education. In this case, as this proportion increases by one standard deviation the proportion of non-teenage mothers and mothers in general decrease by 1 and 1.19 standard deviations respectively, which suggests huge practical effects. These results suggest that education reforms do induce less fertility in adult motherhood but do not seem to have any effect on teenage motherhood. These results contradict the evidence found for OECD countries, where it has been shown that education reduces teenage pregnancies,[2] although the effects are modest. Such literature concludes that attending school has some "incapacitation effect"and leaves less free time for teenagers to engage in sexual

[2] Black et. al (2008), Silles (2010).

activities.

The paper is organized as follows: section 2 presents the theoretical model, while sections 3 and 4 provide descriptive statistics about teenage pregnancy and the compulsory years of education in LAC countries respectively. Section 5 summarizes the empirical framework and section 6 shows the empirical results. Finally, section 7 concludes.

2 A Model

Consider H households where each has one daughter that lives two periods, one as a young woman and one as an adult woman. A woman has to decide whether or not to have children (when young or adult) and then given this decision has to decide the number of children to bear. There are two type of women in the model either being a mother (when young or adult) and not being a mother. Among the former type they have to choose the optimal number of children to bear once the decision of the timing (either when young or adult) of starting to have children is taken. We consider two scenarios for women who decide to become a mother: i) to not study when young and start having children immediately; or ii) to study when young that allows her to obtain a high wage with a certaing probability when adult and postpone having children until adulthood. The women that choose the first option are called *young mothers* while the ones that choose the second are called *adult mothers*. We assume explicitly that young mothers do not study when young due to financial and physical constraints that make this option unfeasible. Also we do not consider women that do not study in their young age and bear children only in their adult age. We abstract from these cases to simplify matters as much as possible.

Assume that in each period the daughter can have sexual intercourse with men and that the time to do this activity in no way alters the time spent in other activities like working or studying. During the first period the household daughter, endowed each period with 1 unit of time, decides whether to have a child or to invest in education postponing childbearing to the second period. If the daughter chooses to invest in education she pays the cost $h > 0$, which includes not only the monetary tuition but also the costs associated with the time spent on this activity. Young mothers have to raise one or more children as unskilled workers during both periods of their lives since they would not be able to study when adult. Childrearing costs per child are given by k which is constant irrespective of whether a woman has children when young or adult.[3]

Unskilled workers earn wage w_u in both periods plus the household economic support from her family (only for her first period of life irrespective of having or not a child as a youth) reflected in a non labor income transfer denoted by x such that $x > h$ which means that household income is enough to pay for the daughter's education in the first period of her life. In the second period a daughter that completes her education level can get a job as a skilled worker earning $w_s(h)$ with probability $\delta(L_s) \in (0,1)$, where we assume $w_s'(h) > 0$ since there are higher returns to school investments. Notice that the function $\delta(\cdot)$ is a

[3] One can imagine that adult women can have a higher effort cost in raising children than a young mother but we abstract from this possibility.

function of the amount of skilled workers with investment h in education. In the short run it seems reasonable to assume that $\delta'(L_s) < 0$ since for a given amount of job offers in the market a greater amount of skilled labor will decline the probability of getting this kind of job, while in the long run it seems reasonable to assume that $\delta'(L_s) \geq 0$ since job offers can increase due to higher productivity at the industry level induced by this type of skilled labor. If a daughter does not get a skilled job position she works as an unskilled worker earning $w_u \equiv w_s(0) > 0$ which is taken as a minimum wage level in the economy. We assume that the *innate fertility* of a woman is constant in time to simplify matters as much as possible.

Assume that the utility function for a woman is additively separable in her two life periods as a function of her consumption levels when young and adult, respectively denoted as c^y, c^a, as well as her motherhood payoff $m(b)$

$$U(c^y, c^a; b) = c^y + \beta c^a + Mm(b)$$

where the discount factor of future utility is $\beta \in (0,1)$, $M = 1$ if and only if the woman becomes a mother during her life time, zero otherwise, $m(b)$ is function of b that is distributed in the support $(0,\infty)$ with $G(b)$ as the corresponding continuous c.d.f distribution function in the population, which denotes the fundamental heterogeneity in motherhood preferences. This heterogeneity captures the idea that some women have different preferences for motherhood than other women which is time independent and is such that $\int_0^\infty dG = H$. The motherhood payoff $m(b)$ is assumed to have the following structure where it depends on the *number of children* that a woman could *physically achieve*, denoted n, as well as the *number of desired children* that she *would like to have*, denoted $n^d(b,h) \equiv \gamma(h)\, b$ where we assume $\gamma(0) > \gamma(h)$ for any $h > 0$ which captures the intuitive idea that more educated women *desire* less number of children. Hence, the motherhood payoff is defined as

$$m(b) \equiv n - \frac{(n - \gamma(h)\, b)^2}{2} \tag{1}$$

The intuition is that a born child yields positive utility for a mother, regardless of the timing of the birth, but there is a disutility of not achieving the *desired* number of children. Hence, if n is different from $\gamma(h)\, b$ then a disutility arises in a symmetric way either by n being strictly greater or smaller than $\gamma(h)\, b$.

The budget constraints for *young* mothers for both periods of her life are

$$c^y = w_u + x - kn; \quad c^a = w_u - kn \tag{2}$$

while the budget constraints for *adult* mothers in both periods of her life are

$$c^y = x - h; \quad c^a = E(w) - kn. \tag{3}$$

where $E(w) \equiv \delta(L_s)\, w_s(h) + (1 - \delta(L_s))\, w_u$ is the expected wage. In what follows we determine the optimal amount of children that a woman would have as well as the timing of her first born.

2.1 Optimal Number of Children

We start solving the model in a backward fashion in the sense that once a woman decides to become a mother (young or adult) she has to decide the number of optimal children to bear, and only then we solve for the timing of her first born child that determines if she is a young or adult mother. To characterize the optimal number of children in each case we solve the optimal number of children in both scenarios that has the following form

$$\begin{aligned} &\max_{n\geq 0} c^y + \beta c^a + m(b,h) \\ &s.t.(1) \text{ and } [(2) \text{ or } (3)]. \end{aligned} \tag{4}$$

Consider first the problem of choosing n for *young mothers* who do not invest in education. The optimization problem (4) boils down to

$$\max_{n\geq 0}\left\{ w_u + x - kn + \beta(w_u - kn) + n - \frac{(n-\gamma(0)b)^2}{2} \right\}.$$

The first order condition (FOC), which are necessary and sufficient since the objective function is a strictly concave function in n, yields

$$-k - \beta k + 1 - n + \gamma(0)b = 0$$

which solves into the number[4] of children for young mothers "ym"

$$n^{ym}(b) = \gamma(0)b + 1 - k(1+\beta)$$

Note that higher costs of childrearing (k) as well as higher values of the discount factor (β) decrease accordingly the optimal number of children achieved by a woman for any given level of b. Moreover, there is a type that is just indifferent between having or not one child which solves $n^{ym}\left(\bar{b}\right) = 1$. Hence, all types that satisfiy $0 \leq b < \bar{b} \equiv \frac{k(1+\beta)}{\gamma(0)}$ would not have children when young delaying this until they are adult or not having children in their lifetime. Replacing $n^{ym}(b)$ into the utility function yields an expected indirect utility for young motherhood as a reduced function of b

$$\begin{aligned} U^{ym} &= w_u(1+\beta) + x + \frac{1}{2} - k + \frac{k^2(1+\beta)^2}{2} \\ &\quad -\beta k + \gamma(0)b(1-k(1+\beta)). \end{aligned} \tag{5}$$

On the other hand, *adult mothers* that choose to delay childbearing to study when young and invest $h > 0$ in education would have to solve (4) which boils down to

$$\max_{n\geq 0}\left\{ x - h + \beta[E(w) - kn] + n - \frac{(n-\gamma(h)b)^2}{2} \right\}$$

[4] The divisibility of children that is assumed is naturally artificial, nonetheless, this simplifies the calculations and could always be approximated to the closest positive integer.

This yields the following first order condition that is also necessary and sufficient

$$-\beta k + 1 - (n - \gamma(h)\, b) = 0$$

which solves into the number of children for adult mothers "am"

$$n^{am}(b) = \gamma(h)\, b + 1 - \beta k.$$

There is a type of adult mothers that is just indifferent between having at least one child when adult and not having any children whatsoever which satisfies $n^{am}(\underline{b}) = 1$. Hence, types that satisfiy $0 \leq b < \underline{b} \equiv \frac{\beta k}{\gamma(h)}$ would not have children even when adult. Note that $\underline{b} < \overline{b}$ if $\beta < \frac{\gamma(h)}{\gamma(0)-\gamma(h)} \equiv \overline{\beta}$ which we assume from here onwards. In this case types that are in the interval $\left(\underline{b}, \overline{b}\right]$ would postpone having a child when young and start to have children when adult. Replacing $n^{am}(b)$ in the utility function yields an expected indirect utility for adult motherhood as a reduced function of b

$$U^{am} = x - h + \beta E(w) + \frac{1}{2} - \beta k + \frac{\beta^2 k^2}{2} + b\gamma(h)(1 - \beta k). \tag{6}$$

2.2 Optimal Timing of Initial Childbearing

Once we have found the indirect utility function of the two scenarios considered above we are now ready to study the optimal timing of initial childbearing. A daughter with non labor income such that $x > h$ would optimally choose to become a young mother (ym) if and only if the expected indirect utility of doing so is no less than the expected indirect utility of postponing it and becoming a mother when adult (am). This boils down in comparing (5) with respect to (6) i.e. $U^{ym} \geq U^{am}$ which yields that young age motherhood is optimal for types that satisfy

$$b \geq b^* \equiv \frac{\beta\delta(L_s)(w_s(h) - w_u) + k - \frac{k^2}{2} - w_u - h - \beta k^2}{(\gamma(h) - \gamma(0))(1 - \beta k) - \gamma(0)\, k}$$

where we assume that parameters are such that the denominator and numerator are positive. Two cases might arise: either $\overline{b} > b^*$ or $b^* > \overline{b}$. Let us define $b_{\min} = \min\left\{\overline{b}, b^*\right\}$ which gives us a threshold type that is just indifferent between having a child when young or when adult which allows us to compute the fraction of household daughters that become young mothers, adult mothers and non mothers respectively

$$d^{ym} = \frac{H - G(b_{\min})}{H}; \quad d^{am} = \frac{G(b_{\min}) - G(\underline{b})}{H}; \quad d^{nm} = \frac{G(\underline{b})}{H}$$

such that $d^{ym} + d^{am} + d^{nm} = 1$.

2.3 Comparative Statics on Compulsory Education Reforms

This simple model allows us to study some comparative statics, specifically on compulsory education that represents an increase in the amount of years necessary to graduate from secondary schooling. This increase

of years of education is reflected in the model as an increase in h, since more time spent in school has to increase overall schooling investment levels. Nonetheless, this increase in h is compensated by an increase in wage $w_s(h)$ since we have assumed that $w_s'(h) > 0$. Moreover, recall that the marginal probability of finding a skilled job $\delta'(L_s)$ varies with the amount of skilled workers in the market. We are interested in studying how this increase in h affects the fractions (d^{ym}, d^{am}, d^{nm}) under a compulsory education reform taking L_s as given in the short run.

First note that an increase in h increases $\underline{b} \equiv \frac{\beta k}{\gamma(h)}$ since $\gamma(h)$ is a decreasing function of h. Hence $\frac{\Delta d^{nm}}{\Delta h} \simeq \frac{G'(\underline{b})}{H}\frac{\Delta \underline{b}}{\Delta h} > 0$ given that $G' > 0$ and $\frac{\Delta \underline{b}}{\Delta h} > 0$. Therefore the model predicts that an increase in compulsory (secondary) education decreases the fraction of mothers in the economy through the decrease in the number of desired children, regardless of the timing, either young or adult mothers. This is due to changes in fertiliy preferences for women that attain higher education levels. Moreover, threshold value b^* changes with an increase in h for fixed L_s since

$$\frac{\partial b^*}{\partial h} = \frac{\beta\delta(L_s)\, w_s'(h) - 1}{(\gamma(h) - \gamma(0))(1-\beta k) - \gamma(0)\, k} - \frac{b^*\gamma'(h)(1-\beta k)}{[(\gamma(h) - \gamma(0))(1-\beta k) - \gamma(0)\, k]^2}$$

which could be increasing or decreasing. If $w_s'(h) > \frac{1}{\beta\delta(L_s)}$ and $\gamma'(h)$ is not so large then $\frac{\partial b^*}{\partial h} > 0$ which says that a compulsory education reform can have the effect of increasing the indifferent type of being a young or adult mother. Hence, the effect of a compulsory education reform has an ambiguous effect on the fraction of adult mothers since

$$\frac{\Delta d^{am}}{\Delta h} \simeq \frac{G'(b_{\min})\frac{\Delta b_{\min}}{\Delta h} - G'(\underline{b})\frac{\Delta \underline{b}}{\Delta h}}{H}$$

has an ambiguous sign given that $\frac{\Delta b_{\min}}{\Delta h} \geq 0$, $\frac{\Delta \underline{b}}{\Delta h} > 0$ and $G' > 0$. We would have $\frac{\Delta d^{am}}{\Delta h} \geq 0$ if investment returns to education, measured as $w_s'(h)$ for a given level of $\delta(L_s)$, are sufficently large to overcome the decrease in the desired number of children that comes with being an educated adult mother, otherwise the model predicts that $\frac{\Delta d^{am}}{\Delta h} < 0$.

Finally, note that the effect of a compulsory education reform has a non positive effect on the fraction of young mothers since

$$\frac{\Delta d^{ym}}{\Delta h} \simeq \frac{-G'(b_{\min})}{H}\frac{\Delta b_{\min}}{\Delta h} \leq 0$$

since $\frac{\Delta b_{\min}}{\Delta h} \geq 0$ and $G' > 0$.

In summary, a compulsory education reform would reduce the fraction of mothers in the economy, would weakly reduce the fraction of young mothers in the economy while most probably would (weakly) increase the fraction of adult mothers if investment returns to education, measured as $w_s'(h)$, are sufficently large to overcome the decrease in the desired number of children that comes with being an educated adult mother. This effect is attenuated for lower values of β and $\delta(L_s)$. Moreover, for a given value of β if $\delta'(L_s) \geq 0$, given that the industry creates more skilled jobs after a compulsory education reform, then it is more likely to have these predictions. On the other hand, if $\delta'(L_s) < 0$, which means that the industry does not create enough

new skilled jobs, then even if $w_s'(h)$ is large we can get $\frac{\partial d^{am}}{\partial h} \leq 0$. Hence, the prediction of a compulsory education reform on adult motherhood is ambiguous and becomes an empirical question.

In order to illustrate the functioning of the model we can construct a simple parameter benchmark to show how the different types self-select themselves. Consider a Weibull c.d.f. for motherhood types in the population $G(b) = 1 - e^{-\left(\frac{b}{\lambda}\right)^{\alpha}}$ for $\lambda = 0.1$ and $\alpha = 2.5$ as well as the following parameter benchmark $\beta = 0.9$, $w_s(h) = 4h + w_u$, $w_u = 0.64$, $h = 0.45$, $k = 0.1$, $\gamma(0) = 1$, $\gamma(0.45) = 0.9$, $\delta(L) = \frac{1}{1+L}$, $L = 0.5$. Under this set up we have that $\overline{\beta} = 9$, $\underline{b} = 0.11$, $\overline{b} = 0.19$ and $b^* = 0.17$ which shows that $\underline{b} < b^* < \overline{b}$ and therefore $b^* = b_{\min}$. Hence, the types self-select themselves as shown in figure 1 where the proportions are $d^{nm} = 0.20$, $d^{am} = 0.29$ and $d^{ym} = 0.51$.

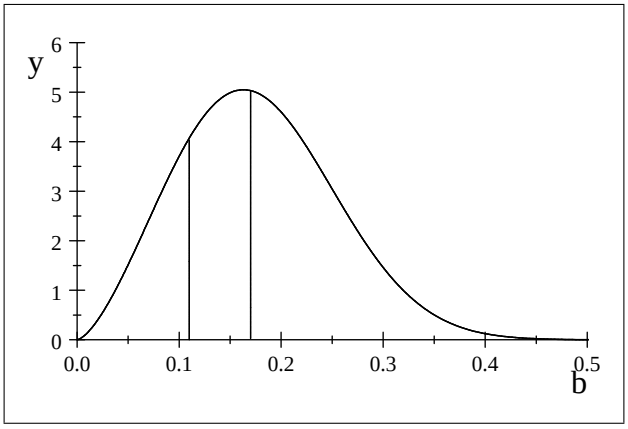

Figure 1

3 Descriptive statistics

This section presents aggregate descriptive statistics for the trend in teenage fertility and childbearing in Latin America and the Caribbean. Several sources of data were used where some present slight discrepancies that will be addressed when relevant. Table 1 shows CEPAL statistics that report teenage childbearing rates (number of teenage mothers among mother women aged 15-19) at the beginning of the 1990's and in 2000's for eighteen LAC countries. These rates vary largely across the different countries. Only four countries have registered a decrease in teenage childbearing rates: Belize, Guatemala, Nicaragua and Paraguay. For the rest of the countries the rate has increased (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Panama, Peru, Uruguay and Venezuela).

Number of mothers per 100 women aged 15-19				
Country		Year		Year
	11,9	1991	12,4	2001
Argentina	16,9	1990	15,8	2000
Belize	11,7	1992	13,5	2001
Bolivia	11,5	1991	14,8	2000
Brazil	11,8	1992	12,3	2002
Chile	14,0	1993	14,3	2004-05
Colombia	12,8	1984	13,2	2000
Costa Rica	n/a	n/a	16,7	2002
Dominican Republic	13,5	1990	16,3	2001
Ecuador	14,4	1992	15,4	2007
El Salvador	16,1	1994	15,5	2002
Guatemala	16,6	1988	18,3	2001
Honduras	10,4	1990	12,1	2000
Mexico	23,9	1995	20,0	2005
Nicaragua	16,1	1990	17,4	2001
Panama	15,0	1992	12,1	2002
Paraguay	11,2	1993	11,5	2007
Peru	8,4	1985	13,9	1995
Uruguay	13,8	1990	15,0	2001

Source: CEPALSTAT

Table 1: Teenage Childbearing Rates across LAC countries

During the 1990's, the highest teenage pregnancy rate was registered by Nicaragua where 24 out of a hundred women aged 15-19 where child bearers. While the rate decreased to 20 in 2005, it is still the highest in the region. In contrast Uruguay had the lowest rate in LAC countries for 1985 and Peru had the lowest one in 2000. Notably the non-teenage childbearing rate has gone down on average in the whole region.

Another statistic that can be reported is the yearly teenage fertility rate, as shown in Table 2, calculated as the number of live birth per 100 women aged 15-19. Information from PAHO is available for the period 1987-2010, and shows a decline for all the countries in the region. The countries are ordered from the one with a smaller reduction to that with the highest reduction. The highest rate is still observed in Nicaragua and the minimum one in Suriname. In 1997, the smallest rate was registered by Suriname and the highest again in Nicaragua. The same countries have respectively the lowest and highest rate in 2010. It is important to note that teenage pregnancy fertility rates vary significantly across countries. In spite of the downward trend registered in all countries there are still three countries with double digit rates.

Number of live birth per 100 women aged 15-19													
Country / Year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Argentina	6,98	6,8	6,62	6,43	6,25	6,07	5,99	5,92	5,84	5,77	5,69	5,62	5,55
Bahamas	6,34	6,18	6,03	5,88	5,73	5,57	5,52	5,46	5,41	5,35	5,3	5,25	5,21
Belize	10,63	10,32	10,02	9,72	9,42	9,12	8,87	8,62	8,37	8,12	7,87	7,7	7,52
Bolivia	8,69	8,64	8,59	8,54	8,49	8,44	8,32	8,19	8,07	7,94	7,82	7,69	7,57
Brazil	8,97	8,97	8,97	8,96	8,96	8,96	8,95	8,95	8,94	8,94	8,93	8,92	8,91
Chile	6,69	6,58	6,48	6,37	6,27	6,16	6,12	6,08	6,04	6	5,96	5,92	5,89
Colombia	8,44	8,25	8,06	7,87	7,68	7,49	7,3	7,1	6,91	6,71	6,52	6,42	6,32
Costa Rica	8,69	8,5	8,31	8,13	7,94	7,75	7,63	7,5	7,38	7,25	7,13	7,02	6,92
Dominican Republic	11,37	11,38	11,39	11,41	11,42	11,43	11,3	11,16	11,03	10,89	10,76	10,62	10,48
Ecuador	8,54	8,52	8,5	8,49	8,47	8,45	8,42	8,38	8,35	8,31	8,28	8,24	8,2
El Salvador	9,52	9,36	9,2	9,03	8,87	8,71	8,59	8,47	8,34	8,22	8,1	8	7,89
Guatemala	12,11	12	11,88	11,77	11,65	11,54	11,38	11,21	11,05	10,88	10,72	10,55	10,39
Guyana	7,83	7,67	7,52	7,36	7,21	7,05	6,9	6,74	6,58	6,43	6,27	6,11	5,95
Haiti	6,19	6	5,81	5,62	5,44	5,25	5,13	5,01	4,88	4,76	4,64	4,55	4,45
Honduras	11,46	11,22	10,98	10,73	10,49	10,25	10,06	9,87	9,69	9,5	9,31	9,14	8,97
Jamaica	9,35	9,24	9,14	9,04	8,94	8,84	8,63	8,43	8,23	8,03	7,83	7,68	7,53
Mexico	7,78	7,62	7,47	7,31	7,16	7	6,9	6,79	6,69	6,58	6,48	6,39	6,29
Nicaragua	13,26	13	12,73	12,47	12,2	11,94	11,8	11,67	11,54	11,4	11,27	11,15	11,03
Panama	9,32	9,24	9,15	9,07	8,98	8,9	8,77	8,64	8,52	8,39	8,26	8,13	8
Paraguay	9,19	9	8,81	8,61	8,42	8,23	8,03	7,83	7,63	7,43	7,23	7,07	6,91
Peru	8	7,67	7,34	7,02	6,69	6,36	6,29	6,22	6,16	6,09	6,02	5,97	5,91
Suriname	5,08	4,96	4,84	4,72	4,6	4,48	4,38	4,27	4,16	4,05	3,95	3,86	3,78
Uruguay	6,73	6,67	6,61	6,56	6,5	6,44	6,37	6,31	6,24	6,18	6,11	6,06	6,02
Venezuela	9,41	9,37	9,33	9,29	9,25	9,21	9,17	9,12	9,08	9,03	8,99	8,94	8,9

Source: OPS

Table 2: Teenage fertility rate

In this paper, we use different sources in order to describe the evolution of teenage pregnancy in LAC countries. Our sample consists of data for 22 countries (depending on the availability of specific information for each of the indicators under analysis). The sources of our databases are shown in Table 3. The main source of data is the Socioeconomic Database for Latin America and the Caribbean (SEDLAC), jointly developed by CEDLAS at the Universidad Nacional de La Plata (Argentina) and the World Bank's LAC poverty group (LCSPP). This database contains information on more than 200 official household surveys for 25 LAC countries. All variables in SEDLAC are constructed using consistent criteria across countries and years as well as identical programming routines in order to generate micro data to measure poverty and inequality. We used this databases and re-processed them in order to obtain cohorts of women born in different years. We then construct the proportion of teenage and non-teenage mothers per cohort and a series of related educational and economic variables. Our older cohorts were born in 1965, and the younger ones during the 1990's.

Country	Survey	Period	Changes in compulsory education
Argentina	Encuesta Permanente de Hogares	1992-2002	Yes
	Encuesta Permanente de Hogares-Continua	2003-2009 (II semester)	
Bahamas	Bahamas Living Conditions Survey	2001	Yes
Belice	Labour Force Survey	1994, 1997-1999	No
Bolivia	Encuesta Integrada de Hogares	1992	No
	Encuesta Nacional de Empleo	1997	
	Encuesta Continua de Hogares- MECOVI	1999-2002, 2005, 2007	
Brazil	Pesquisa Nacional por Amostra de Domicilios	1981-1990, 1992, 1993, 1995-1999, 2001-2009	Yes
Chile	Encuesta de Caracterización Socioeconómica Nacional	1987, 1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009	Yes
Colombia	Encuesta Nacional de Hogares - Fuerza de Trabajo	1992, 1996, 1999-2000	Yes
	Encuesta Continua de Hogares	2001, 2003, 2004	
	Gran Encuesta Integrada de Hogares	2006, 2007	
Costa Rica	Encuesta de Hogares de Propósitos Múltiples	1989-2009	Yes
Dominican R.	Encuesta Nacional de Fuerza de Trabajo	1996, 1997, 2000-2009	No
Ecuador	Encuesta de Condiciones de Vida	1994, 1999	No
	Encuesta Periódica de Empleo y Desempleo	1995, 1998, 2000	
	Encuesta de Empleo, Desempleo y Subempleo	2003-2009	
El Salvador	Encuesta de Hogares de Propósitos Múltiples	1991, 1995, 1996, 1998-2008	No
Guatemala	Encuesta Nacional de Condiciones de Vida	2000, 2006	No
	Encuesta Nacional de Empleo e Ingresos	2002, 2003-2004	
Haiti	Enquête sur les Conditions de Vie en Haïti	2001	Yes
Honduras	Encuesta Permanente de Hogares de Propósitos Múltiples	1991-1999, 2001-2009	No
Jamaica	Jamaica Survey of Living Conditions	1990, 1996, 1999, 2001-2002	No
Mexico	Encuesta Nacional de Ingresos y Gastos de los Hogares	1989, 1992, 1994, 1996, 1998, 2000, 2002, 2004-2006, 2008	Yes
Nicaragua	Encuesta Nacional de Hogares sobre Medición de Nivel de Vida	1993, 1998, 2001, 2005	No
Panama	Encuesta de Hogares, Mano de Obra	1989, 1991	Yes
	Encuesta de Hogares	1995, 1997-1998, 2001-2006, 2009	
Paraguay	Encuesta de Hogares (Mano de Obra)	1990, 1995	Yes
	Encuesta Integrada de Hogares	1997, 2001	
	Encuesta Permanente de Hogares	1999, 2002-2009	
Peru	Encuesta Nacional de Hogares	1997-2009	Yes
Uruguay	Encuesta Continua de Hogares	1992, 1995-1998, 2000-2009	Yes
Venezuela	Encuesta de Hogares Por Muestreo	1989, 1992, 1995, 1998, 2000-2006	Yes

Table 3

4 Schooling Reforms in LAC countries

LAC countries have registered significant changes in their mandatory schooling requirements over the past twenty years. The last column of Table 3 lists all countries and the year where changes in educational requirements were introduced. During the early nineties a significant number of countries increased the number of years from primary or elementary education (with an average of 6 to 7 years) in order to include some years of high school education. Presently none of the countries in the sample has less than nine years of compulsory education. After 2000 some countries in the sample increased again their legal prerequisites along the way to extending it to secondary education. As of 2011, high school is compulsory in only three countries: Argentina, Venezuela and Uruguay.

One relevant issue about the change in the number of compulsory years of education is enforcement, especially for LAC. For most countries, there is no enforcement of such legal mandate. However, it is also documented (Alzua et al, 2010) that even when there is no legal enforcement, enrollment and attendance

may increase for two reasons: i) school investment returns are higher due to the fact that formal firms often require the completion of mandated schooling in order to hire employees, ii) social norms and peer effects that function as de facto enforcement. The debate about the quality of education in LAC is a relevant one. PISA scores show a relatively weak position of LAC versus other countries with similar per capita GDP. If the number of schooling years increase, but the quality of education decreases or at best remains stagnant, then the effect on teenage pregnancy rates may be attenuated.

5 Empirical Strategy

As previously mentioned, an interesting policy question that emerges is whether education reforms that increase the mandatory years of education for youths have any effect on the fertility decisions of women. A *reduced* form relationship between these variables can be estimated as equation (7) below specifies in details:

$$FD_{c,i} = \alpha_0 + \alpha_1 ER_{c,i} + \theta_c + \gamma_i + \varepsilon_{c,i} \tag{7}$$

where $FD_{c,i}$ represents the proportion of women in cohort c and country i with different fertility decisions FD: teenage motherhood, non teenage motherhood and motherhood in general. The main independent variable of interest is a variable that represents an education reform change denoted ER. We use two type of variables for ER, one that is a dummy variable that takes the value one if cohort c and country i had an educational reforms $\left(ER^1\right)$, zero otherwise, which captures the extensive margin of an educational reform on fertility decisions; another proxy variable for ER is the amount of years that the education reform increased for mandatory schooling $\left(ER^2\right)$ for cohort c and country i, which captures the intensive margin of the education reforms. Moreover the specification decomposes the error term in cohort effects θ_c, country fixed effects γ_i and an idiosyncratic term $\varepsilon_{c,i}$. These country fixed effects control for unobservables that are constant through countries.

The second specification that we consider is one that is more *structural* in nature and comes directly from our theoretical framework which represents a *transmission mechanism*: average education attainment ($Educ$) has an effect on fertility decisions. Importantly, beyond what the theoretical model suggests, there are reasons to believe that fertility and schooling decisions may be jointly determined, which in turn yields a potential endogeneity problem for $Educ$. We use then ER as an instrumental variable for $Educ$ under the identifying assumption that education reforms affect fertility decisions indirectly, only through its effect on average educational attainment ($Educ$). This assumption is quite reasonable since education reforms should affect the average education attained in the population in a given country but should not affect directly fertility decisions. Hence, our structural specification is equation (8):

$$FD_{c,i} = \beta_0 + \beta_1 Educ_{c,i} + \eta_c + \lambda_i + \epsilon_{c,i} \tag{8}$$

where $Educ_{c,i,t}$ represents the education attained in cohort c and country i while the error term has cohort effects and fixed effects across countries. The instrumental variable approach is represented by the additional

equation (9):

$$Educ_{c,i} = \pi_0 + \pi_1 ER_{c,i} + \xi_c + \upsilon_i + \nu_{c,i} \tag{9}$$

Given the nature of the educational reforms we use three different proxy variables for $Educ_{c,i,t}$: the proportion of women in cohort c and country i during year t with only primary education, the proportion of women with incomplete secondary and the proportion of women with complete secondary and/or tertiary education.

6 Empirical Results

6.1 Education Reforms and Fertility Decisions

The theoretical model suggests that education reforms have an ambiguous effect on fertility decisions for women and can only be resolved empirically. Table 4 reports estimation of the reduced equation (7) of the effect of educational reforms on the proportion of women in each cohort who became mothers. The table shows three different models that have as dependent variables the proportion of teenage mothers, the proportion of non-teenage mothers and the proportion of mothers irrespective of the age they gave birth in each cohort. As can be observed, the educational reforms (extensive in column 1 and intensive in column 4) that were implemented in LAC countries have had no statistically significant effect on the proportion of teenage mothers in the region. However, the results showed in columns two and three in Table 4 present a different story. In particular, we find that education reforms had a statistically significant negative extensive effect $\left(ER^1\right)$ on the proportion of non-teenage mothers and motherhood in general for all cohorts that were affected by education reforms. Moreover, we find at the intensive margin that an increase in a standard deviation in the number of years of schooling that education reforms induced is associated statistically with a decrease in the proportion of non-teenage motherhood and motherhood by 0.16 and 0.17 standard deviations respectively. As can be observed, statistical results are found for these proportions either when ER^1 or ER^2 are used as main independent variables.

Dependent variable: Proportion of women in each age cohort that are mothers

	Models					
	(1)	(2)	(3)	(4)	(5)	(6)
	Teenage mothers	Non-teenage mothers	Mothers	Teenage mothers	Non-teenage mothers	Mothers
Education Reform Dummy	-0,0025	-0.037***	-0.040***			
	(0,005)	(0,006)	(0,009)			
Number of mandatory years of Education				0,0004	-0.0085***	-0.0081***
				(0,0013)	(0,002)	(0,002)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	501	501	501	501	501	501
R-squared	0,766	0,952	0,957	0,766	0,951	0,956

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Reduced Form Regressions

These empirical results suggest that education reforms reduced motherhood in general as the theoretical model predicts. Moreover, the results show that adult motherhood decreased while not affecting teenage motherhood. These results are present beyond the negative trend in fertility rates for more recen cohorts since the cohort dummies (not reported) are negative for more recent cohorts in LAC countries. This latter result according to the theoretical model arises since investment returns to education were not sufficently large to overcome the decrease in the desired number of children that comes with being an educated adult mother.

6.2 Education Attainment and Fertility Decisions: an IV approach

We are also interested in studying the transmission mechanism through which education reforms change fertility decisions at the aggregate level. The theoretical model shows that education reforms can affect education returns as well as lowering women preferences on childbearing. The structural econometric model of equation (8) states that education attainment has an effect on fertility decisions. Since education and fertility decisiones for women are jointly determined then OLS estimation of equation (8) would not yield the causal effect for women of education attainment on fertility decisions. Equation (9) states that education attainment was increased ($\pi_1 > 0$) by implementing education reforms which allows us to use ER (either ER^1 or ER^2) as an IV for $Educ$ in equation (8) to identify and estimate consistently β_1, which is the causal effect of education attainment on fertility decisions.

The data does show that countries that implemented education reforms were able to increase significantly the average number of years of education for women since the mean years of education attained by women in countries that implemented an education reform is nine years while it is only seven for countries that did not, a difference that is statistically significant.

Dependent variable: Proportion of women in each education level

	Models					
	(1)	(2)	(3)	(4)	(5)	(6)
	Complete Primary education	Incomplete Secundary education	Complete Secondary or some tertiary education	Complete Primary education	Incomplete Secondary education	Complete Secondary or some tertiary education
Education Reform Dummy	-0,00811	-0.0154**	0.0243***			
	(0,0073)	(0,0074)	(0,0080)			
Number of mandatory years of Education				-0,00237	-0.00558***	0.00796***
				(0,0018)	(0,0017)	(0,0020)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	501	501	501	501	501	501
R-squared	0,971	0,841	0,933	0,971	0,842	0,933

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: First Stage Regressions

Table 5 reports the first stage regression of equation (9). Each column presents the first stage results of a regression that has as dependent variable the proportion of women in a given cohort in each country that attains primary education, the proportion of women with incomplete secondary education and finally those who have completed secondary education and/or have some tertiary education too. Specifically, the first three columns present the results using as instrumental variable ER^1 (dummy variable of education reform) while the last three columns have as instrumental variable ER^2 (number of mandatory years of education each cohort of women was subject to). The results have the same direction and are statistically significant only for education attainment of incomplete and complete secondary as well as tertiary schooling.

Education reforms did not have a statistical effect on primary school attainment, as one would consider to be the case, since all education reforms in LAC countries involved increasing the years to graduate from secondary school. The coefficient associated with the ER's is not significant at any standard level in a regression that has as dependent variable the proportion of women with only a primary education level in each cohort and country.

A completely different result is found for the proportion of women with some secondary education and the proportion with complete secondary education or some tertiary education. In the first case, the implementation of the education reforms decreased the proportion of women who did not complete secondary education. If we use as the main explanatory variable ER^2 (the number of mandatory schooling year) it is found that one additional year of mandatory education decreases this proportion in 0.08 standard deviations. Additionally, the reforms had a positive and significant effect on the proportion of women who completed their secondary education and may had some tertiary education too. Countries that implemented such educational reforms increased on average this proportion of women in 0.08 standard deviations.

The results presented in table 5 are interesting and are quite the expected ones. As was detailed before, most of the educational reforms used in this paper increased the number of mandatory school years in secondary education. With the exception of Colombia and Brazil all countries had a mandatory level of education which was higher than primary education and yet almost 44% of women did not attain it. Then, not finding a significant effect of the reform on these women is not at all surprising. These educational reforms have however shifted the distribution of education of women to the right decreasing the proportion of women with incomplete secondary education and increasing the proportion of women with complete secondary education and/or some tertiary education.

Dependent variable: Proportion of women in each age cohort that are mothers

	Models								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Teenage mothers	Non-teenage mothers	Mothers	Teenage mothers	Non-teenage mothers	Mothers	Teenage mothers	Non-teenage mothers	Mothers
Proportion of women with primary education	0,314	4,646	4,96						
	(0,693)	(3,955)	(4,294)						
Proportion of women with incomplete secondary education				0,165	2.443*	2.608*			
				(0,343)	(1,340)	(1,467)			
Proportion of women with complete secondary education or more							-0,105	-1.550***	-1.654**
							(0,215)	(0,579)	(0,659)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kleibergen-Paap rk Wald F statistic	1,235	1,235	1,235	4,4	4,4	4,4	9,73	9,73	9,73
Chi-sq(1) P-val	0,2553	0,2553	0,2553	0,0308	0,0308	0,0308	0,0018	0,0018	0,0018
Observations	501	501	501	501	501	501	501	501	501
R-squared	0,475	0,115	0,25	0,53	0,484	0,584	0,534	0,73	0,784
Number of countries	22	22	22	22	22	22	22	22	22

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: IV regressions

Table 6 presents the results obtained in the second stage regression which estimates the causal effect of education attainment on the decision of becoming a mother using ER1 as the instrumental variable.[5] The first noticeable fact is the difference in power of the educational reforms. As expected, given the results obtained in the first stage, the instrument chosen does not have any power in the estimation where the proportion of women with primary education is the independent variable. On the contrary, in the regressions where the proportion of women with incomplete or complete secondary education is the independent variable the reforms have substantial statistical power instrument at the 3% and 1% respectively.

The results show that the proportion of women in each cohort who only attain primary education has no impact on the fertility decisions of neither teenage nor adult mothers in that given cohort. Specifically, it has no effect on the proportion of women in these cohorts who become mothers. On the contrary these proportions are influenced by the proportion of women with incomplete secondary and with complete secondary or tertiary education. The results suggest that as the proportion of women who attains incomplete secondary education increases in one standard deviation the proportion of adult women who become mothers increase by one standard deviation. A very similar impact is found for the proportion of mothers in a given cohort irrespective of their age. Interestingly, the opposite effect is found having as main independent variable the proportion of women with complete secondary and some tertiary education. In this case, as this proportion increases by one standard deviation the proportion of non-teenage mothers and mothers in general decrease by 1 and 1.19 standard deviations respectively, which suggests a huge practical effect. These results suggest

[5] Although not shown, the results using the number of mandatory years of education in each country give very similar results and are available upon request.

that education reforms do induce less fertility in the adult population but do not seem to have any effect on teenage motherhood. So the question that gives the title for this paper is clearly no, education reforms does not reduce teenage pregnancy.

These results are compatible with the theoretical model since education reforms that increase compulsory secondary years of education decrease motherhood in general and specifically reduce adult (non-teenage motherhood) if the returns to schooling are not strong enough to overcome the negative effect of women preferences on childbearing, which seems to be the case empirically for LAC countries in the period studied.

7 Conclusions

Teenage pregnancy and childbearing are generally believed to be associated with worse labor market and educational outcomes for mothers. Latin America and the Caribbean have one of the highest teenage pregnancy rates of the world (World Bank 2012). Importantly, several LAC countries are increasingly targeting policies to reduce teenage pregnancies. While there is a growing body of literature that studies the effect of several policies on teenage pregnancy in developed countries, literature is scarce in developing countries, specifically for LAC countries. Education often appears as one of the key factors that may contribute to the reduction of teenage pregnancies. Measuring such causal effect, if exists, is a difficult task due to the potential endogeneity of schooling decisions. We develop a theoretical model that yields predictions on the effect of education on teenage, non-teenage motherhood and the number of children. We then test the model using a unique database comprising surveys for 22 countries of LAC countries. We utilize surveys available since the eighties and are able to track back cohorts born after 1965. We explore regional variations in the number of compulsory years of education for several LAC countries as an instrument for education attainment. We do not find a reduction in teenage pregnancy caused by an increase in the compulsory years of education. However, we do find a reduction in non-teenage motherhood and an increase in non motherhood. Our results suggest that implementing education reforms that increase the number of years of mandatory secondary schooling for young women in LAC countries have somehow changed women's preferences of becoming a mother, specifically for adult more mature women while not having any effect on younger girls. These results go in hand with the predictions of our model.

The contribution of our research is threefold. First, we develop a model in order to account for optimal time of initial childbearing in the presence of education reforms. Secondly, we test the prediction of such model using data for developing countries. Finally, we use a large and comprehensive database of 22 LAC countries that has never been used to study this issue.

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