FERTILITY AND CHANGING PATTERN OF CHILDBEARING TIMING IN COLOMBIA

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ABSTRACT

Background: Colombia`s total fertility rate (TFR) reached the replacement level of 2.1 in 2010, making it a low fertility country. Studies show that the long observed early childbearing pattern characteristic of Latin American countries might be changing in Colombia, in particular for highly educated women, yet detailed analysis is lacking. In low fertility contexts, changes in the timing of motherhood are vital for interpreting period fertility measures and anticipating future trajectories.

Objective: This study analyses fertility changes in Colombia since 1990 and examines how the timing of childbearing has changed by birth order and across birth cohorts. The relationship between education and timing of motherhood is analysed in-depth across cohorts.

Methods: Data from five rounds of Demographic and Health Survey conducted between 1990 and 2010 are used. To analyse period trends in the timing of childbearing and how they shaped the observed trend in the TFR, order specific mean age at birth and tempo adjusted TFR are calculated. Discrete time logit models are fitted in order to understand what changes in the transition to first and second birth took place across cohorts and educational groups.

Results: Opposing trends in the timing of first and higher order births are found, with early transition to motherhood existing alongside postponement of second births. A halt to the decrease in age at first birth is documented. These processes contribute to the end of inflating effect of the changes in the timing of childbearing on period fertility. Multivariate analysis reveals that norms relating to later transition to motherhood are not only emerging among women with university education but are also observed in groups of women with lower educational levels. At the same time, postponement of second births is observed among women in all educational strata.

Conclusion: With continuation of the documented trends and further educational expansion, depressing effect of the changes in the timing of childbearing on TFR could be expected in the coming years in Colombia, possibly bringing it to below replacement level.

1. INTRODUCTION

Fertility decline affects the size, growth rate and age structure of contemporary populations. Many Latin American countries have experienced notable fertility declines during the second half of the Twentieth Century, with some of them approaching, and others already below, replacement level fertility. Although Colombia's total fertility rate (TFR) is 2.1 children per women, little is known about the dimensions of the fertility decline there. Even less is known about the timing of childbearing and how it has changed across parities and cohorts.

Fertility decline in Colombia has been accompanied by a stable, or at times decreasing, age at first birth. There is evidence, however, that the timing of childbearing is changing across Latin America and the shift away from early childbearing is particularly pronounced among highly educated women (Rosero-Bixby et al. 2009). In addition to establishing that a growing proportion of women in their twenties did not make the transition to motherhood in the region as a whole, their study found that the change observed in Colombia between the two last censuses was particularly pronounced, as compared to both other countries and previous time periods. This change together with the fertility reaching low levels warrants the examination of the processes underlying these changes.

The paper uses data from five rounds of the Colombia Demographic and Health Surveys (CDHS) conducted between 1990 and 2010. First, this study examines how the timing of childbearing has changed across all birth orders in the last two decades. Previous analyses have focused on the transition to first birth. Very little attention has been paid to studying the timing of parities higher than one and existing studies are outdated (Bongaarts 1999). In the next step, Bongaarts and Feeney`s (1998) method is used to estimate the tempo effect of fertility. If childbearing postponement at the population level is an emerging phenomenon in Colombia and women transition to motherhood later, period fertility indicators will be affected by these changes. It is therefore important to study to what extent the fertility decline in Colombia has been due to the increasing age at childbearing. Knowledge about the tempo effects at all parities is crucial for the interpretation of past, as well as future fertility.

Second, this study uses event history analysis (discrete time logit models) to analyse changes in the timing of childbearing across cohorts. Specifically, the transition to first and second birth are investigated. The models assess if, and to what extent, the risk of birth of a given order increases or decreases with regard to women`s birth cohort. Finally, this study examines in detail the relationship between women's education and the timing of motherhood. Changes in the risk of transition to first and second birth within educational groups across cohorts are analysed. This is to clarify how the timing of childbearing has differed not only between women with different levels of education, but also how it has been changing within these subgroups. This is the first analysis of changes in the timing of childbearing in Colombia using statistical models and incorporating the most recent (CDHS 2010) survey data.

2. BACKGROUND

2.1. FERTILITY TRANSITION IN COLOMBIA AND LATIN AMERICA

The evolution of fertility declines in Latin America has been widely documented (Guzman et al. 1996, Heaton et al. 2002). A characteristic of the region has been sustained fertility decline without significant change in the timing of onset of childbearing (Rosero-Bixby 1996, Fussel and Palloni 2004, Rosero-Bixby et al.2009).

The absence of a trend in delayed motherhood was attributed to a stalling, and at times increasing teenage fertility, a so called “fertility rejuvenation” process associated with least-educated and poorest women (Chackiel and Schkolnik 1996, Florez and Nunez 2002, Berquo and Cavenaghi 2005, Bozon et al.2009). Changes in the levels of adolescent fertility were related to changes in the initiation of sexual activity which, in countries such as Brazil or Colombia, worked towards rising teenage childbearing and increasing the contribution of women aged 15-19 years to total fertility. Cavenaghi and Alves (2009) refer to the religious culture in Spanish speaking countries with its influence on the contraceptive method mix. In some countries, such as Peru, the method choice concentrated around traditional methods such as withdrawal and periodic abstinence, widely practiced among young women (Raguz 2009). In other countries, such as Brazil and Colombia, the heavy reliance on sterilisation and low use of spacing methods with women often adopting no contraception until they reach their desired number of children prevailed. This was put forward as one of the reasons underlying the absence of an emergence of later motherhood and lack of modification of the reproductive career (Bonneuil and Medina 2009, Goldani 2009). Consequently, the fertility decline among women aged 15-25 has been substantially lower than for women over 25 years old, shifting the peak of the curve depicting the age-specific fertility rates towards younger age groups. Fussell and Palloni (2004), on the other hand, explain the early childbearing pattern in terms of strong cultural emphases on family ties and value placed on family networks as influencing early and universal family formation processes.

Colombia has one of the lowest TFRs in Latin America, a decline which started in the mid Twentieth Century. Colombia’s TFR reached a replacement level of 2.1 in 2010, down from 6.6 children in the 1960s (Salamanca and Rodriguez 2011). Fertility decline in the 1960s and 1970s in Colombia was attributed to the influence of the Profamilia family planning programme. The introduction of Profamilia and increased availability of modern contraceptives allowed young women aged 15-19 years to postpone first births through lowering the costs of delaying motherhood (Miller, 2005). However, as seen elsewhere in Latin America in the 1990s, Colombia experienced increasing teenage fertility (Chackiel and Schkolnik 1996).

Changes in pre-marital sexual activity were an important proximate determinant of this process (Florez and Nunez 2002).

Rosero-Bixby et al. (2009) and Esteve et al. (2012) found that proportions of women below the age of 30 who become mothers had declined substantially across Latin America. This is a new phenomenon not observed in the region before the beginning of the 21st Century. Analysis of the available 2000 census rounds showed that growing proportions of women in their twenties had not made the transition to motherhood. This means that young cohorts are departing from the, until recently, persistent early and universal childbearing pattern and that postponement of fertility at the population level might be under way. Rosero-Bixby et al (2009) highlighted that Colombia exhibits an extreme case with respect to the timing of entry into motherhood. The proportion of women aged 25-29 years who made a transition to motherhood dropped by more than ten percentage points between the 1993 and 2005 census (from 82% to 70%, respectively). This new trend deserves further investigation as its continuation might have a substantial influence on the already low levels of TFR in Colombia.

2.2. FERTILITY LEVEL AND TIMING OF CHILDBEARING

The level of the TFR is influenced by changes in the timing of childbearing (tempo) and the total number of children women have (quantum) (Ni Bhrolchain 1992, Bongaarts and Feeney 1998). Distinguishing between these two components of fertility is important for understanding and interpreting this synthetic period measure of the level of fertility. The TFR is prone to more fluctuations than cohort fertility measures and in a situation when women postpone or advance fertility, the tempo effects distort the period age-specific fertility rates, and induce a temporal variation in the TFR. Consequently, if there has been a recent increase in the age at childbearing, the TFR will be lower than it would have been in the absence of timing changes. Conversely, when women are accelerating entrance into motherhood, the TFR will be inflated. The importance of changes in the timing of childbearing has been crucial in understanding the emergence of low and lowest low fertility levels in European countries (Frejka and Calot 2001, Kohler and Ortega 2002, Sobotka 2004, Myrskyla et al. 2013). It is, however, an aspect largely unexplored and rarely studied in the Latin American context, despite changes in fertility and entrance into motherhood in the region. Moreover, the evidence from a limited number of studies shows that analysis of tempo changes of fertility is needed outside the context of countries most advanced in the process of fertility transition (e.g. Bongaarts 1999, Grace and Sweeney 2013).

2.3. TIMING OF CHILDBEARING AND EDUCATION

Literature on changes in the timing of childbearing, in particular first birth postponement, provides a wide description of factors contributing to this phenomenon. These pertain to increases in women`s education, less family-centred and traditional values orientation, increasing career opportunities, use of effective contraception, partnership changes or economic conditions such as unemployment, housing conditions or availability of supportive family policies (Rindfuss et al. 1988, Kohler et al. 2002, Sobotka 2004, Billari et al. 2006, Mills et al. 2011).

The effect of prolonged education on childbearing postponement has been documented to be one of the most important factors. There is consensus in the literature that highly educated women are the forerunners in the process of delayed transition to motherhood, as staying in education contributes directly to the reduced risk of having a first child (Rindfuss et al. 1988, Blossfeld and Huinink 1991, Hoem 2000). Previous research on Latin America in particular, found a very strong relationship between transition to motherhood and education with highly educated women being less likely to experience first birth at younger ages (Weinberger et al. 1989, Castro-Martin and Juarez 1995, Heaton and Forste 2009, Rios-Neto and Meireles Guimaraes 2014, Chackiel and Schkolnik 1996).

Whereas at the individual level there is a clear association between the childbearing postponement and education, the aggregate population level changes in the timing of parenthood can be attributed to either the compositional change with respect to education (rising educational attainment) or change over time in the association between the outcome and the predictor variable (Ni Bhrolchain and Beaujouan 2012, Neels et al. 2014). The effect of education on delayed childbearing is considered to work through two processes. First, through additional postponement of first birth within each educational category. Second, through widening differences in the timing of first birth between the educational groups, with most highly educated individuals postponing motherhood to a greater extent (Rindfuss et al. 1996, Sobotka 2002).

Cross-country studies investigating these processes in Latin America are consistent in stating that emerging changes in the timing of childbearing have been associated with the most educated strata of women, primarily those with university education (Rosero-Bixby et al.2009, Esteve et al.2012). According to these authors, the female education level in Latin America has increased significantly since the 1970s, however it was only recently that particularly pronounced expansion of secondary and university education occurred, which might have been an important factor for the onset of delayed childbearing at the population level in the region. Nevertheless, the authors suggest that not only compositional changes could have contributed to this process. They document that in several countries of Latin America, including Colombia, increases in the proportion of women who have not proceeded to motherhood within the educational groups has occurred. Studies capturing the extent of these changes using statistical models, however, are lacking.

3. DATA

The study uses cross-sectional, secondary data from five rounds of nationally representative Colombian Demographic and Health Survey (CDHS) conducted in 1990, 1995, 2000, 2005, 2010. These collect information about women of all marital statuses aged 13-49 with sample sizes range from 7412 in 1990 to 51447 in 2010[1]. In the first part of the analysis all survey rounds are used. In the latter part of the study emphasis is put on the CDHS2010. For the analysis, birth recodes as well as individual women recodes are used. These contain women's detailed birth histories and information about the socio-economic characteristics of individuals.

4. METHODS

This section describes the methods used in the study. The analysis is performed in STATA Software (StataCorp 2013) and DHS datasets are weighted by the sample weights as specified by Rustein and Rojas (2006) using the survey design function.

4.1. FERTILITY AND TIMING OF CHILDBEARING TREND ANALYSIS

First, the trends in fertility and the timing of childbearing by birth order are examined. Second, an analysis of how changes in the timing of childbearing shaped observed trend in the TFR between 1990 and 2010 is conducted.

<u>Order-specific period fertility</u>

The period changes in the timing of childbearing are examined by calculating the mean ages at birth by parity across the DHS rounds. In order to follow the evolution of changes in the first- and higher-order births, trends in TFR and its birth order components ($TFR_{x,\ x=1,2,3,4,5+}$) are calculated.

The TFR and its birth order components are obtained from the period age-order-specific fertility rates calculated from birth histories using STATA software tfr2 module as described by Schoumaker (2013). First the events (births) and exposure in age groups for three years preceding the survey for a given birth order are computed, in the next step the Poisson regression is used to calculate the fertility rates. The TFR birth-order components calculated this way have the same interpretation as the TFR while referring to the

[1] Datasets were obtained from the DHS Program website: http://www.dhsprogram.com/

specified birth order for which they are calculated. The corresponding mean ages at birth of different birth orders are computed.

The tempo-adjusted order-specific total fertility rates (adjTFR$_i$)

To account for the tempo changes in the TFR$_i$, the adjTFR$_i$ measure developed by Bongaarts and Feeney (1998) is applied. In the calculation of the tempo-adjusted order-specific fertility rates the annual changes in the mean age at each of the birth orders are incorporated. This is done to obtain a hypothetical measure of the level of fertility that would be observed in a given period if there was no change in the timing of births. This allows a study of the influence of birth timing on the level of the TFR and is calculated in the following way:

$$adjTFR_i = TFR_i/(1 - r_i) \tag{1}$$

TFR_i – observed total fertility rate in a given year at order *i* [2]

r_i – annual rate of change in the mean age at childbearing at order *i*

The increase in the mean age results, therefore, in the adjusted rate to be greater than the observed fertility value, whereas a decrease in the mean age results in the adjusted number of births being smaller than the unadjusted one. If no changes in the timing of births by parity occurred, the adjusted and unadjusted rates are of the same value. The adjusted TFR is calculates by summing all of the obtained birth-order values (adjTFR$_i$) obtained from the above procedure in the following way:

$$adjTFR = \sum adjTFR_i \tag{2}$$

4.2. MULTIVARIATE ANALYSIS OF THE TIMING OF CHILDBEARING

To analyse changes in the timing of first and second birth across cohorts and educational groups, an event history discrete-time logit model is applied to the 2010 DHS women`s recode. The model is described by the following equation (Yamaguchi 1991):

$$\ln\left\{\frac{\lambda(t_i;X)}{[1-\lambda(t_i;X)]}\right\} = a_i + \sum_{i=1}^{k} b_k X_k \tag{3}$$

Where $\boldsymbol{\lambda(t_i;X)}$ is the probability of the event at a time *t* given that the event did not happen before *t* (a hazard function); **a**$_i$ is the constant terms representing the baseline hazard at time *t;* $\sum_{i=1}^{k} \boldsymbol{b_k X_k}$ describes the effects of explanatory variables on the hazard.

[2] Indicators calculated up to the birth order four, higher birth orders combined to the category 5+

The time-discrete logit model was chosen because of the discrete character of the variable of interest – time to event (first birth or second birth) in years, which together with the big sample size of the 2010 DHS (51447 women) allows to handle ties in an appropriate manner (Yamaguchi 1991). The dataset for the analysis has been transformed into the unit-period one as described by Box and Steffensmeier (2004, p. 70). Four models were fitted:

I. interval between age 10 and age at first birth
II. interval between first birth and second birth
III. interval between age 10 and age at first birth with an interaction between the birth cohort and education variable
IV. interval between first birth and second birth with an interaction between the birth cohort and education variable

The information about the age at first and second birth is derived from the women`s recode which reports exact year in which a women gave birth to her children (if any). Age 10 is taken as the beginning of the interval in the models since it is the age for which first birth is reported among respondents who have ever given birth to a child. In the model which analyses the age at first birth the dependent variable is a dummy variable which indicates whether the event happened or the observation was censored. In the model examining the first to second birth interval analogously the time of second birth is analysed for women who have had at least one child. In each case the dependence of hazard on time is unrestricted with a dummy variable for each study time (e.g. T=10,11,…,49 in the first birth model). In the models, apart from the variables describing cohort and education level (highest education level attended), socio-economic characteristics have been controlled for: place of residence, region of residence and ethnicity. All of the variables are included as time-constant. The lack of distinction between the current status and status at the time of birth in DHS is a limitation when conducting event history analysis. For example, considering education, in a situation when a woman obtained further education after having the first child, the current status measure at the time of the survey will not reflect the level attended while being at risk of pregnancy. Some studies attempt to cope with this issue by reconstructing education histories assuming that women enter school at the age when children should formally start schooling in a given country and progress through education levels normally (e.g. Grace and Sweeney 2014). The assumption of this procedure is quite strong however, and such procedure has not been employed here.

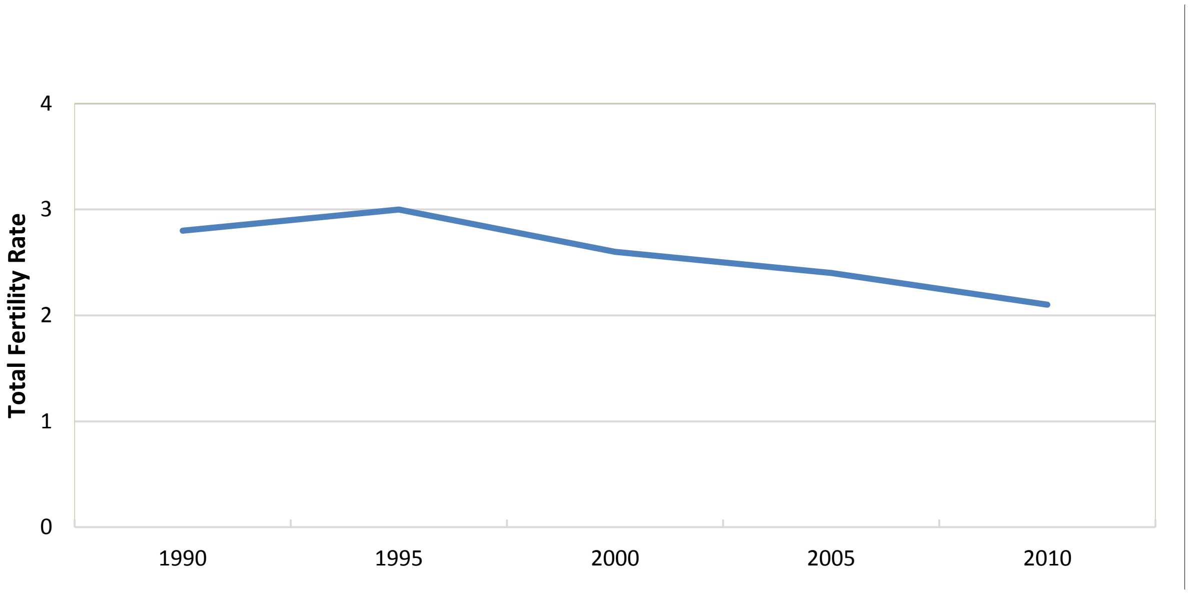
In the model analysing the interval between first and second birth the age at first birth is controlled for.

5. RESULTS

5.1 FERTILITY AND TIMING OF CHILDBEARING TREND ANALYSIS

Graph 1 shows the trend in the total fertility rate in Colombia throughout the 20 year period. The TFR reached the replacement level in 2010, however in 1995 the decline was interrupted by a temporary plateau.

Graph 1: Total fertility rate, Colombia 1990-2010

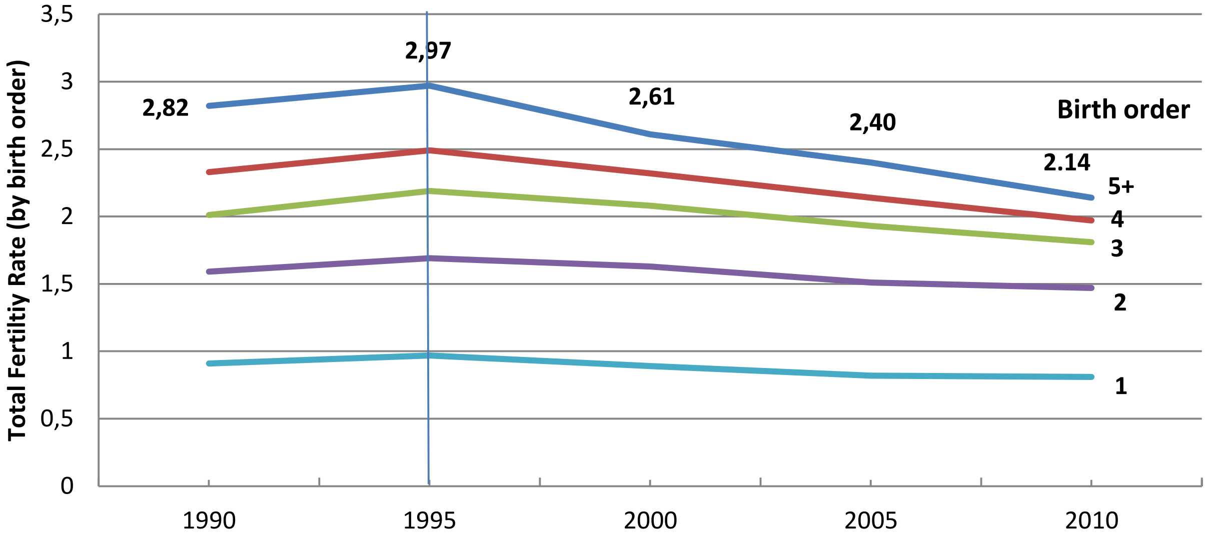


Source: Author's calculations from individual datasets

<u>Order-specific births</u>

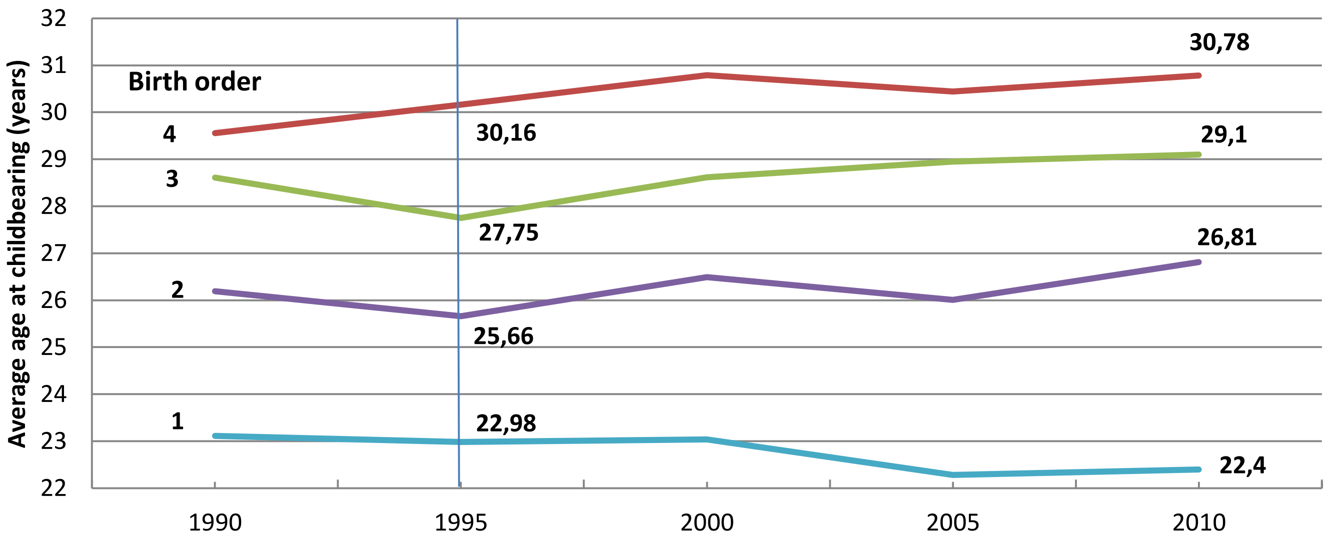
Trends in TFR and its birth order components (*Graph 2*) reveal that the TFR decrease in the last 20 years in Colombia, although interrupted in 1995, was almost entirely due to decreases in the fertility of the highest birth orders (3, 4 and 5+ children). The contribution of parities 1 and 2 to the TFR decline between 1990 and 2010 was much smaller. Nevertheless, after an initial increase in the total fertility rate in 1995 due to increases in TFR_1, TFR_2 and TFR_3, the total fertility rates for all birth orders declined.

Graph 2: Total fertility rate by birth order, Colombia 1990-2010



Source: Author's calculations from individual datasets

Graph 3: Mean age at birth by parity, Colombia 1990-2010



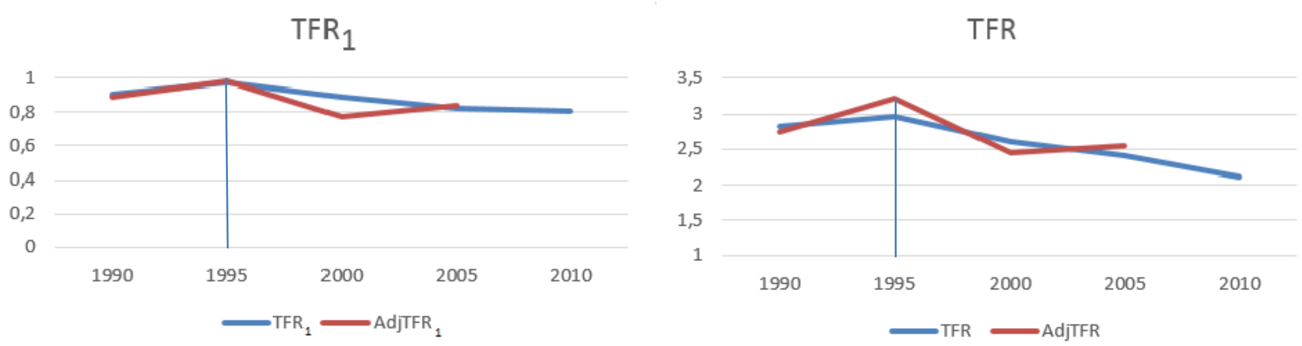
Source: Authors calculation from individual datasets

Graph 3 contributes to an explanation of the observed initial increase and, subsequent decrease in TFR between 1990 and 2010. The decrease in the mean age at lower parity births between 1990 and 1995 resulted in a temporary increase in the TFR. Since the year 1995 two divergent trends in the mean age at birth could have been observed: stalled or decreasing age at first birth and, although exhibiting fluctuations, increasing age at higher parity births. Whereas the age at first birth in 2010 was at a level even lower than observed in 1995, the opposite change occurred for the higher order births, suggesting postponement of higher order births, however, without the first birth postponement.

The observed divergence of the trends in the mean age at first and second birth means that women in Colombia continued having their first child at an early age, at times advancing the transition to motherhood, whilst postponing transition to subsequent births. A feature of fertility patterns in Colombia since 1995 was having children of higher parity later, but starting childbearing early.

The tempo-adjusted order-specific total fertility rates

Graph 4: Total fertility rate (TFR) and tempo-adjusted total fertility rate (adjTFR), Colombia 1990 - 2010



Source: Author's calculation from individual datasets

Graph 4 allows for further investigation of the levels and timing of fertility at parity one and total fertility rate. Since 1995 there was a decrease in the mean age at birth of the first child. In the absence of such a decrease, the TFR_1 would have been lower than the observed one which is represented by the $AdjTFR_1$ being below TFR_1 in 2000. After 2005 however, the trend towards decreasing age at first child came to a halt (adjusted and unadjusted TFR values are equal). This means that since 1995 there was a tempo inflating effect of first births to the observed change in TFR.

These changes are reflected in trends in the TFR of all parities. The advancement of childbearing produced a fertility level that would have been lower if the mean age at birth not decreased in year 2000. In the consecutive period, however, the adjusted TFR is higher than the observed TFR marking the end of the previous fertility inflating effect of earlier childbearing. Interestingly, in the periods in which the age at first birth was stable (where TFR_1=$AdjTFR_1$ in 1995 and 2005) the adjusted TFR (AdjTFR for all birth orders) was higher than the observed TFR. These findings suggest that the tempo changes of first order births worked towards increasing fertility whereas those of the higher orders births, towards decreasing it. Since 1995 the TFR has been declining steadily. The finding of the presence of negative tempo effect of first births and, although exhibiting fluctuations, positive tempo effect of higher birth orders suggests that the fertility decline since 1995 was both due to the quantum of fertility effect and a small tempo effect of higher order births.

These results rely highly on the accuracy of the data used for the analysis. The calculated measures of fertility obtained from surveys such as DHS are subject to variety of errors (sampling and measurement errors) which might influence the reliability of the estimates and, consequently, obtained fertility measures. Although according to Bongaarts and Feeney (1998) survey samples might be too small to derive reliable measures, other studies show that the tempo adjustments performed using DHS can provide insight into fertility changes (Bongaarts 1999). In this study, non-negligible fluctuations in the mean age at birth by parity exist. Divergent trends in the mean age at first and second birth are further explored through the analysis of the risk of transition to first and second birth using event history analysis of CDHS 2010.

5.2. MULTIVARIATE ANALYSIS OF TIMING OF CHILDBEARING

Table 1: Discrete-time logit models: age 10 to first birth (I), first birth to second birth (II)[3]

Age 10 to first birth		
	Odds ratio	**Std. Err.**
Cohort		
1990-95	0,64	0,03***
1985-89	0,94	0,03*
1980-84	1,00	-
1975-79	0,98	0,03
1970-74	0,91	0,03***
1965-69	0,79	0,02***
1960-64	0,72	0,02***
Region		
Bogota	1,00	-
Atlantica	0,98	0,03
Oriental	1,00	0,03
Central	0,91	0,03***
Pacifica	0,91	0,03***
Territorios Nactionales	1,33	0,05***
Residence		
Urban	1,00	-
Rural	1,09	0,03***
Education		
No Education	1,00	-
Primary	0,85	0,06*
Secondary	0,53	0,04***
Higher	0,21	0,01***
Ethnicity		
Other	1,00	-
Native Colombian	1,02	0,04
Black/Afro-Colombian	1,12	0,03***

Note: Reference category has an odds ratio of 1,00
†$p<0.10$; *$p<0.05$; **$p<0.01$; ***$p<0.001$

First birth to second birth		
	Odds ratio	**Std. Err.**
Cohort		
1990-95	0,38	0,04***
1985-89	0,73	0,03***
1980-84	1,00	-
1975-79	1,21	0,04***
1970-74	1,43	0,05***
1965-69	1,63	0,05***
1960-64	1,72	0,06***
Region		
Bogota	1,00	-
Atlantica	1,35	0,05***
Oriental	1,12	0,04***
Central	0,91	0,03**
Pacifica	0,85	0,03***
Territorios Nacionales	1,12	0,04**
Residence		
Urban	1,00	-
Rural	1,27	0,03***
Education		
No Education	1,00	-
Primary	0,85	0,05**
Secondary	0,62	0,04***
Higher	0,45	0,03***
Ethnicity		
Other	1,00	-
Native Colombian	1,15	0,05**
Black/Afro-Colombian	1,14	0,04***
Age at first birth		
<18	1,00	-
18-21	0,75	0,02***
>21	0,46	0,01***

Note: Reference category has an odds ratio of 1,00
†$p<0.10$; *$p<0.05$; **$p<0.01$; ***$p<0.001$

Source: Author's calculation from individual dataset (DHS 2010)

[3] The dummy variables of the baseline hazard at each study time have been omitted from the output

According to the results of the multivariate regression model (I), controlling for other explanatory variables, the risk of giving birth to the first child was increasing for women born after 1965, a highly statistically significant association. This means that women were accelerating entrance into motherhood, a result consistent with the previous findings (see 5.1). This trend however came to a halt with cohorts born in 1975-79 and the results suggest that women born after 1985 delayed their first birth relative to the experience of women in the baseline group. For women born in 1985-89 the odds of the hazard of first birth were lower by 6%, compared to women born in 1980-84. For women born in 1990-95 such odds were lower by 36%. This means the reversal of the observed trend towards earlier transition to motherhood which was characteristic of older cohorts.

These changes were occurring hand in hand with an increasing interval between the first and the second child. This is represented by the continuously decreasing hazard of having a second child across all cohorts for women who are already mothers, a highly significant result in model (II). This was also the case for cohorts for which the increasing risk of first birth has been identified. These findings are in line with the results presented in *Graph 3* which revealed the trend towards increasing mean age at second birth without an increase, or at times decreasing, mean age at first birth. This result is obtained while controlling for the age at first birth which means that in each consecutive cohort women were postponing transition to the second birth.

Education appears to be the strongest factor associated with the timing of childbearing, inversely related to the risk of first, as well as second birth. Respondents attending higher education have the odds of first birth risk lower by 79% compared to women with no education, holding other explanatory variables constant. For highly educated women who are already mothers, the odds of the risk of the second child are lower by 55% when compared with women with no education.

Among other explanatory variables, the place of residence has a significant effect on the timing of childbearing. Living in a rural area is associated with an increased risk of having a first, as well as the second child, controlling for other variables. The association between the risk of having a second child for mothers and place of residence is particularly strong, with women living in rural areas having the odds of the hazard higher by 27% than women living in urban areas. This means that once women in rural areas have a first child, they progress faster to a second one, compared to urban residents. Moreover, women living in Central and Pacifica regions are at a lower risk of having a first, as well as the second child when compared to Bogota. The opposite direction of the association is found for those living in Territorios Nacionales. Inclusion of the Ethnicity variable in both models reveals that the risk of first birth is higher for Black/Afro-Colombian women than for Native Colombian and women in category “Other”. Moreover, not only are Black/Afro-Colombian women entering motherhood earlier, they are also spacing the first and the second birth more tightly. Shorter spacing of first and second birth is also a characteristic of native Colombian women.

5.2.1 TIMING OF CHILBEARING AND EDUCATION LEVEL

Transition to first birth

Two models with an interaction term between the level of education and the birth cohort were fitted: one for women born in years 1960-79 (older cohorts) and one for those born in years 1980-95 (younger cohorts). The rationale for dividing the sample in such a way is twofold: the nature of the variable used to describe the cohort (the continuous variable of the year of birth) and the change in the trend of increasing risk of first birth for cohorts born in 1980, presented in the model (I).

Table 2: Discrete-time logit models: age 10 to first birth, interaction term between the year of birth and education level (III and IV)

Older cohorts (1960-79) (III)				**Younger cohorts(1980-95) (IV)**			
	Coef.	**Std. Err.**	**Odds ratio**		**Coef.**	**Std. Err.**	**Odds ratio**
Year of birth	-0,001	0,003	0,999	**Year of birth**	-0,121	0,009***	0,886
Education				**Education**			
No Education	1,237	0,948		No Education	-7,993	3,410*	
Primary	-0,819	0,334*		Primary	-9,821	1,107***	
Secondary	-0,976	0,281***		Secondary	-3,773	0,886***	
Interaction				**Interaction**			
No education	-0,001	0,014		No education	0,116	0,040**	
Primary	0,027	0,005***		Primary	0,137	0,013***	
Secondary	0,023	0,004***		Secondary	0,068	0,010***	

Note: Reference category of education variable: higher

Year of birth is a continuous variable cantered around year 1900

Control variables as in the model (I), omitted from the output

†p<0.10; *p<0.05; **p<0.01; ***p<0.001

Source: Author's calculation from individual dataset (DHS 2010)

Considering both models, there is a statistically significant difference in the trend of the risk of first birth for women with primary and secondary education, as well as for women with no education for younger cohorts. All compared to women attending higher education. This means that the relationship between the risk of first birth and birth cohort has been different by educational groups.

Moreover, the models provide evidence that the relationship between the timing of childbearing and education level changed over time. The coefficient of *Year of birth variable* represents the trend of the risk of first birth for women in the reference category - higher education. For older cohorts (model III) it is close to 0 indicating that the risk of first birth has not been changing for consecutive cohorts in the same educational group. On the other hand, for the cohorts of women born after 1980 (model IV) there is a statistically significant decline in the hazard of first birth for younger women: the odds of the risk of first birth decrease by 11% with each increment in the year of birth. This means that women attending higher education born after 1980 are increasingly postponing their transition to motherhood, a trend not observed for older cohorts.

The decrease in the risk of first birth for women born after 1980 have been smaller for other educational groups, as represented by the positive coefficient of the interaction term. This means growing disparities in the changes of the timing of childbearing for distinct groups. In line with the previous literature on the relationship between education level and timing of first births (e.g. Rindfuss et al. 1996), in Colombia individuals with more years of education are postponing motherhood to a greater extent than those with fewer years of education. To obtain information about the magnitude and whether the change in the risk of first birth has been statistically significant by itself for particular educational groups, the same models have been fitted by changing the reference category of education variable (*Table 3)*.

Table 3: Discrete-time logit models: age 10 to first birth, interaction term between the year of birth and education level

Year of birth (by education ref. cat.)	Year of birth coef.		Std.Err.		Odds ratio	
	Older	Younger	Older	Younger	Older	Younger
No education	-0,002	-0,005	0,014	0,039	0,998	0,995
Primary	0,026	0,016	0,003***	0,009†	1,026	1,016
Secondary	0,022	-0,063	0,003***	0,004***	1,023	0,939
Higher	-0,001	-0,121	0,003	0,010***	0,999	0,886

Note: Reference category of education variable: higher

Year of birth is a continuous variable cantered around year 1900

Control variables as in the model (I), omitted from the output

†p<0.10; *p<0.05; **p<0.01; ***p<0.001

Source: Author’s calculation from individual dataset (DHS 2010)

For women with no education, the risk of first birth has not changed between birth cohorts for either of the cohort groups. The changes described for women with no education are not statistically significant and the estimates have big standard errors. This is due to the small proportion of women with no education in the sample. For women with primary and secondary education there was a shift in the trend of the risk of first birth. Consequently, older cohorts exhibit an increasing risk of first birth and the younger cohort show either no statistically significant change (primary education) or a slight decrease in such risk (secondary education). This means that whereas women with fewer years of education in older cohorts continued to have children at even younger ages, this is no longer true for younger cohorts. Moreover, younger cohorts of women attending secondary education are starting to postpone the transition to motherhood, a change in the direction of the trend observed for older cohorts.

Transition to second birth

A model with an interaction term between the level of education and the birth cohort was fitted for the interval between the first and the second birth, controlling for the age at first birth. No distinction has been made between the two cohorts as in the case of first births, because no change in the trend of transition to second birth between the cohorts has been identified in the model (II). Results in *Table 4* show statistically significant interaction term between the year of birth and educational level, indicating the differentiated magnitude of the change in the risk of second births for women who are already mothers between the subgroups.

Table 4: Discrete-time logit models: first birth to second birth, interaction term between the year of birth and education level (V)

All cohorts (1960-1995) (V)	**Coef.**	**Std. Err.**	**Odds ratio**
Year of birth	-0,058	0,003***	0,944
Education			
No Education	-1,873	0,559**	
Primary	-2,102	0,288***	
Secondary	-1,311	0,265***	
Interaction			
No education	0,037	0,007***	
Primary	0,038	0,004***	
Secondary	0,022	0,004***	

Year of birth (by education ref. cat.)	**Year of birth coef.**	**Std.Err.**	**Odds ratio**
No education	-0,021	0,007***	0,979
Primary	-0,020	0,002***	0,980
Secondary	-0,036	0,002***	0,965
Higher	-0,058	0,003***	0,944

Note: Year of birth is a continuous variable cantered around year 1900
Control variables as in the model (II), omitted from the output
†*p*<0.10; **p*<0.05; ***p*<0.01; ****p*<0.001
Reference category of education variable: higher

Source: Author’s calculation from individual dataset (DHS 2010)

The model shows that, contrary to the results obtained from the model describing the risk of first birth, the risk of second birth for women who are already mothers was continuously decreasing across all birth cohorts for all educational groups. This is represented by the statistically significant and declining odds of the hazard of second birth by 5.5 % for women with higher education and 2% for women with primary education with each increase in the year of birth. The results suggest that although women attending higher education were most likely to postpone transition to second birth, a trend in the same direction could have been observed for all educational groups.

6. DISCUSSION

The present study provides an analysis of the changes in the fertility and the timing of childbearing in Colombia. This analysis demonstrated that fertility decline in the country since 1995 occurred in spite of the fertility inflating tempo effect of first births. Nevertheless, evidence of a halt in the trend towards earlier childbearing in Colombia has been found. Such changes can be viewed as positive considering studies which emphasise the adverse economic, social and health related implications of early and, in particular, adolescent motherhood, which in Colombia has been an issue of major concern in recent years (Florez and Nunez 2002). Although age at first birth in Colombia is still low, this study demonstrated a changing pattern of the timing of childbearing. Norms relating to later motherhood have not only emerged among women attending university, but are also spreading to lower educational groups. Finally, for younger cohorts of women, in none of the educational groups analysed the trend toward earlier entrance into parenthood is observed.

The decreasing risk of first birth across younger cohorts of women attending secondary and higher level educational institutions provides evidence of the changes in the timing of first birth within educational groups in Colombia. This will have implications for the future changes in the timing of childbearing at the population level. In 1990 around 55% of women have ever attended secondary or higher education, the corresponding value in 2010 was around 75% (DHS STATCompiler). If the educational expansion in Colombia continues, not only will the compositional population changes with regard to education work towards pushing the age at first birth upwards, the additional postponement of childbearing within these groups will further intensify the process. These findings suggest that the general trend towards delayed motherhood at the population level in Colombia is highly plausible in the future. Considering that once the postponement transition is initiated, it usually continues (Kohler, Billari and Ortega 2002), an increase in the mean age at first birth in Colombia could be expected. The period fertility indicators are likely, therefore, to fall to below replacement levels. These findings should be considered while interpreting the past and the future period fertility measures.

The second important contribution of this study is the incorporation of the examination of the timing of motherhood with respect to not only first, but also higher order births. In spite of the negative first birth tempo effect in Colombia in the last two decades, small positive fertility inhibiting effect of the changes in the timing of childbearing of higher birth orders has been found. Event history analysis of the transition to first and second birth demonstrated that even among cohorts which were at higher risk of first birth, decreasing risk of transition to second birth was present. This suggests that each consecutive cohort of women was increasingly postponing transition to second birth. This occurred without a similar process for birth order one. Moreover, although most pronounced among highly educated women, the decreased risk of transition to second birth has been found across all educational groups. Therefore, the period fertility decline in the future could be further enhanced by the continued decreasing risk of transition to second birth. These results complement our knowledge about fertility changes in countries where fertility fell to replacement levels and, although changing, norms favouring early motherhood have long prevailed. The findings from Colombia do not fit into the pattern of fertility changes observed in other countries where the postponement of higher parity births usually started after the postponement of first births, a consequence of the initial process of later entrance into motherhood (Sobotka 2004). The exploration of the factors underlying these processes could be a direction for further research.

In Colombia the earlier initiation of sexual activity of young people which was not accompanied by an uptake of contraception was suggested as a reason for increased fertility at younger ages in the 1990s (Ali, Cleland and Shah 2003). The dominance of sterilization in the contraceptive mix was suggested as a reason for reduced birth spacing, accompanied by a reduction of fertility at higher parities (Bonneuil and Medina 2009). Given the findings presented here, the role of the contraceptive use in the observed changes in the timing of childbearing could be further explored to explain the coexistence of the trend towards having fewer children and later transition to second birth, while still entering motherhood early. Little is known about women`s use of contraceptive methods by parity in Colombia, which could cast light on observed changes in the timing of childbearing.

This study not only clarifies the nature of the fertility decline in Colombia, but also adds to the literature describing the fertility transition in Latin America. The results presented here highlight the importance of decomposition of fertility and timing of childbearing trends by birth order, to be able to understand the past and possible trajectories of future fertility trends in region. Extensive research has analysed the transition to first birth in Latin America, however, the childbearing pathways after transition to first birth are poorly understood. There is scarcity of studies on this issue in Latin America. It could be a direction for further research to explore the differences in the fertility and timing of childbearing by birth order in countries in the region which are approaching, or are already below replacement level fertility.

The analyses have limitations. The study did not incorporate analysis of the relationship between union status and timing of childbearing. This could be further explored in terms of analysing whether the changes in the patters of entrance into motherhood have been accompanied by similar changes in patterns of union formation. Moreover, the use of time-constant variables in the event history analysis in a situation when the variable could have taken other value when a woman was at risk of pregnancy, an issue discussed in the section 4.2, is a limitation. Lastly, the applied TFR adjustment technique is a way of studying the effects of changes in the timing of childbearing on fertility which has its limitations, extensively discussed elsewhere (Van Imhoff and Keilman 2000, Kohler and Philipov 2001). The joint analysis of the TFR, fertility by parity and adjusted TFR together with event history analysis used in this study did, nevertheless, deepen our understanding of fertility changes in Colombia. Further analysis should be conducted for other countries in Latin America to better understand ongoing fertility changes and the demographic future of the region.

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