FERTILITY AND TIMING OF CHILDBEARING IN COLOMBIA

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As prepared for the Population Association of America annual conference 2015

ABSTRACT

Colombia joined the group of low fertility countries in 2010, when its TFR reached replacement level. Recent studies show that the long observed early childbearing pattern in the country might be changing, but little is known about the dimensions of the fertility decline. The present research addresses this by studying the changes in the timing and quantum of fertility across parities and cohorts in Colombia during the last two decades. The analysis of five rounds of DHS revealed opposing trends in the timing of first and higher order births. Using event history analysis I show that the advancement of first births across cohorts occurred alongside postponement of second births. These findings are analysed with regard to women's educational levels and show a changing pattern of the timing of childbearing not only across cohorts but also within educational groups. The results should be considered when interpreting the past and future changes in Colombia's TFR.

1. INTRODUCTION AND OBJECTIVES

Fertility decline is one of the most important factors affecting the size, growth rate and age structure of contemporary populations. Consequently, many countries in Latin America have experienced notable fertility declines during the second half of the century, with some of them approaching, and others already below the replacement level. Colombia is one of the countries undergoing demographic changes leading to the ageing of its population (CELADE 2013). In spite of the fact that total fertility rate there is already at the level of 2.1 children per women, little is known about the dimensions of the fertility decline in the country.

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

In the context of recent fertility decline in Colombia several questions remain unanswered. To what extent have the changes in the tempo of fertility shaped the observed trend in the total fertility rate? How has the timing of childbearing changed across cohorts? What has been the relationship between the timing of childbearing and level of education? The presented paper aims to analyse the fertility decline trajectory in more depth. It uses the data from five rounds of the Colombia Demographic and Health Surveys (CDHS) conducted between 1990 and 2010 which is an underexplored source of data in the analysis of the timing of childbearing in Colombia, in particular CDHS 2010.

First, this study examines how the timing of childbearing has been changing across all birth orders in the last two decades. Due to the until recently persistent stability of the first birth timing and the rejuvenation of fertility schedule both in Colombia and the region as a whole, previous analysis focused mainly on examining the transition to first birth. Very little attention has been paid to studying the timing of childbearing of parities higher than one and existing studies are outdated (Bongaarts 1999). In the next step, the Bongaarts and Feeney`s (1998) method is used to estimate the tempo effect of fertility. The justification for such as analysis is that if the childbearing postponement on the population level is an emerging phenomenon in Colombia and women start their transition to motherhood later in life, the period fertility indicators will be affected by these changes. It is therefore important to study to what extent the fertility decline in the country has been due to the increasing age at childbearing. The knowledge about the tempo effects at all parities is crucial for the interpretation of the past, as well as future total fertility rate trajectories.

In the second part, the changes in the timing of childbearing across cohorts are analysed using event history analysis - the discrete time logit model. The transition to first and second birth is investigated and the models are a way to assess if, and to what extent, the risk of birth of a given order increases or decreases with regard to women`s birth cohort. Lastly, being one of the most important determinant of the timing of childbearing in Colombia and Latin America as a whole, this study examines in detail the relationship between the education level and the timing of motherhood. The changes in the risk of transition to first and second birth within educational groups across cohorts are analysed to clarify how the timing of transition to childbearing has differed not only between women with different levels of education, but also how it has been changing within these subgroups. This enhances the understanding of the changes in the timing of transition to motherhood both across cohorts and across educational groups, which is of particular importance for considering the future fertility trajectories in Colombia given the educational expansion in the recent decades in the country.

2. BACKGROUND

2.1. FERTILITY TRANSITION IN COLOMBIA AND LATIN AMERICA

The evolution of fertility decline in Latin America has been widely documented (Guzman et al. 1996, Heaton et al. 2002). Although the general fertility change from high to low levels in Latin America resembles this observed in other countries, an unquestionable demographic characteristic of the region was sustained fertility decline which occurred without the change in the timing of onset of childbearing (Rosero-Bixby 1996, Fussel and Palloni 2004, Rosero-Bixby et al.2009).

The lack of a trend towards delayed motherhood was attributed to a stalling, and at times increasing teenage fertility - 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). 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 to younger age groups. The changes in the level of adolescent fertility were related to the 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 15-19 to total fertility. Cavenaghi and Alves (2009) additionally refer to the religious culture in Spanish speaking countries with its influence on the contraceptive method mix. In some, such as Peru, the method choice concentrated around traditional methods, widely practiced among young women (Raguz 2009). In other countries, such as Brazil and Colombia, the heavy reliance on sterilisation, the neglect of limiting methods, with women often adopting no contraception until they reach their desired number of children, was seen as one of the reasons underlying the absence of the change towards later motherhood and lack of modification of the reproductive calendar (Bonneuil and Medina 2009, Goldani 2009). Fussell and Palloni (2004), on the other hand, explain the phenomenon in terms of the strong cultural emphasis on family ties and value placed on family networks as influencing early and universal family formation process.

Colombia is one of the Latin American countries with lowest levels of total fertility rate which started to decline there in the mid of the 20th century, reaching the replacement level of 2.1 in 2010 – a change from the level of 6.6 in 1960s (Salamanca and Rodriguez 2011). Fertility decline in 1960 and 1970s in Colombia was particularly abrupt when the Profamilia family planning programme, introduced in 1950, was scaling up its operations. According to the study of Miller (2005) about the impact of the programme on fertility, the introduction of Profamilia and availability of modern contraceptives allowed young women in the age group 15-19 at that time to postpone the first birth through lowering the cost of delaying motherhood. Yet, similarly as in other Latin American countries throughout the 1990s, Colombia experienced a trend towards increasing teenage fertility (Chackiel and Schkolnik 1996). The earlier than before initiation of sexual activity meant that in spite of the fact that a substantial proportion of girls in Colombia formed unions at early ages which had implications on early reproduction, these were the changes in the pre-marital sexual activity that were more important proximate determinant of teenage fertility (Florez and Nunez 2002).

The latest analysis of transition to motherhood in Latin America revealed, however, evidence of the changes in childbearing behaviour in the region. Rosero-Bixby et al. (2009) and Esteve et al. (2012) found that proportion of women below the age of 30 who become mothers has dropped substantially across Latin America. This is a new phenomenon not observed in the region before the beginning of the 21st century. The analysis of the available 2000 census rounds showed that growing proportion of women in their twenties has not made the transition to motherhood. This means that young cohorts are departing from the, until recently, persistent early and universal childbearing pattern and the postponement transition on the population level with regards to the motherhood might be under way. The study on the transition to motherhood of Rosero-Bixby and colleagues (2009), apart from providing evidence on the possibility of the start of the postponement transition in the region, also points to the fact that Colombia exhibits an extreme case in that respect. Authors find that the change in the proportion of women in the age group 25-29, as derived from 1993 census, compared to 2005 census who made a transition to motherhood in Colombia dropped by more than ten percentage points (from 82% to 70%, respectively). Similarly, the study of Esteve et al. (2012), using the same data, ascertain that in several countries, among others in Colombia the postponement phase has begun. This is a new trend as the change occurred on the scale never before observed in Colombia. It deserves further investigation as its continuation might have a substantial influence on the levels of the total fertility rate (TFR), which in Colombia has approached low levels.

2.2. TEMPO AND QUANTUM OF FERTILITY

The total fertility rate (TFR) levels are influenced by the 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 behaviour 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 consequently 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 be in the absence of timing changes. Similarly, when women are accelerating entrance into motherhood, the TFR will be inflated. The importance of fertility tempo – quantum interactions have 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, in spite of the pronounced demographic changes occurring in the region. Moreover, the evidence from limited number of studies shows that the analysis of the tempo and quantum of fertility is justified also 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

The existing body of literature about the changes in the timing of childbearing, in particular focusing on the first birth postponement, provides a wide description of factors contributing to this phenomenon. These pertain to the increases in women`s education, less family-centred and traditional value orientation, increasing career perspectives, use of effective contraception, partnership changes or economic conditions such as unemployment situation, 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 of the factors. There is a consensus throughout 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). The past 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 a first birth in young 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). Considering the latter one, the effect of education on the delayed childbearing is considered to work through two processes. First of all through additional postponement of first birth within each of the educational categories, and second of all, widening differences in the timing of first birth between the educational groups, with most highly educated individuals postponing motherhood to a greater extent. Often those with fewer years of education continue starting childbearing in early ages (Rindfuss et al. 1996, Sobotka 2002).

The existing cross-country studies investigating these processes in Latin America are consistent is stating that the emerging changes in the timing of childbearing has 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 1970s, however it was only in recent years that particularly pronounced expansion of the secondary and university education occurred, which might have contributed to the onset of delayed childbearing on the population level in the region. Nevertheless, the authors also document that in several countries of Latin America, including Colombia, there has occurred increases in the proportion of women who have not proceeded to motherhood within the educational groups, suggesting that not only the compositional changes could have contributed to this process. Studies capturing the extent of the latter changes, however, are lacking.

3. DATA

The study uses cross – section, secondary data from five rounds of nationally representative Demographic and Health Survey (DHS) conducted in 1990, 1995, 2000, 2005, 2010, which collects information about women aged 13-49 with sample sizes ranging 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 special emphasis is be put on the DHS2010. Published data utilized for the analysis are obtained from the STATCompiler and DHS reports (Macro International Inc. 1990, 1995, 2000,

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

2005, 2010). Remaining calculations use birth recodes as well as individual women recodes which contain women birth histories and the information about the socio-economic characteristics of individuals.

4. METHODS

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

4.1. FERTILITY TREND ANALYSIS

The purpose of this part of analysis is to study to what extent the observed fertility decline in the TFR in the period analysed (1990-2010) has been the result of reduction of births by parity and to what extent it has also been accompanied by the changes in the timing of childbearing.

Period and cohort age-specific fertility rates

The age-specific fertility rates schedules, derived from STATCompiler, are compared throughout the available DHS rounds to determine whether there is any indication of shift of births to older ages from the period perspective.

To examine how the age-specific fertility rate pattern has been changing between the cohorts, the period-cohort age-specific fertility rate schedules are calculated from birth histories. The measures are derived using the methodology described by Moultrie, published on the UNFPA and IUSSP Tools for Demographic Estimation[2]. This method allows calculating the measures of interest for five-year periods preceding each survey year (here derived from 2010 DHS). The following formula is used to derive the cohort-period fertility rates:

$$f_{i,j} = \frac{1}{5}\left(\frac{B_{i,j}}{N_i}\right)$$

N_i – number of women in a given birth cohort i (i = 1960-64, 1965-69, 1970-1974, 1975-1979, 1980-84, 1985-89)
$B_{i,j}$ – aggregate number of births *j* years ago to women in cohort *i* at the survey date
(j = 0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34)

[2] http://demographicestimation.iussp.org

Order-specific period fertility

This part of analysis is focus on direct examination of the timing of childbearing by calculating the mean ages at birth by parity across the DHS rounds. Moreover, to follow the evolution of the changes in the first- and higher-order births, the trends in TFR and its birth order components ($TFR_{x,\ x=1,2,3,4,5+}$) are be calculated for available DHS rounds.

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 only the specified birth order for which they are calculated. Moreover, the corresponding mean ages at birth of different birth orders are also 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 had there been no change in the timing of births. This allows to study the influence of the birth timing on the level of the TFR and is calculated in the following way:

$$adjTFR_i = TFR_i \,/\, (1 - r_i)$$

TFR_i – observed total fertility rate in a given year at order *i* [3]
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 would result 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 would be 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:

$$adjTFR = \sum adjTFR_i$$

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

4.2. ANALYSIS OF THE TIMING OF CHILDBEARING AND ITS DETERMINANTS

To analyse the relationship between the timing of childbearing across cohorts and educational groups, the 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):

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

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;* $\boldsymbol{\sum_{i=1}^{k} b_k X_k}$ describes the effects of explanatory variables on the hazard.

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 cohort and education variable
IV. interval between first birth and second birth with an interaction between the 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 (firstbirth) which indicates whether the event happened (firstbirth=1) or the observation was censored (firstbirth=0). 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 ones. The lack of distinction between the current status and status at the time of birth in DHS is problematic when conducing the event history analysis, in particular when the education variable is considered. 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 of education 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 that comes with such a procedure are quite strong however, and such procedure has not been employed here.

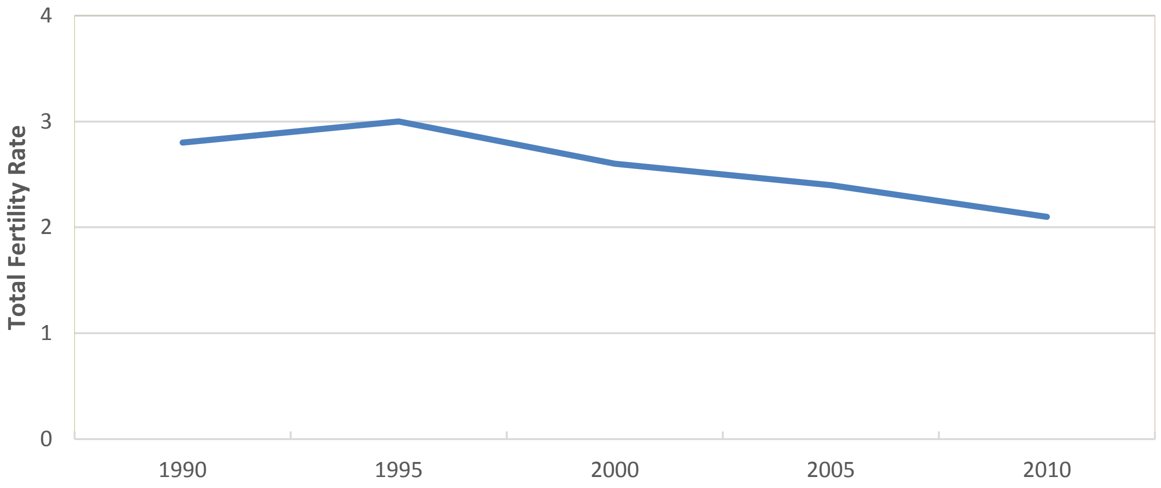
In the model analysing the interval between first and second birth the age at first birth is controlled for.

5. RESULTS

5.1 FERTILITY TRENDS

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

Graph 1: Total fertility rate, Colombia 1990-2010



Source: DHS final reports

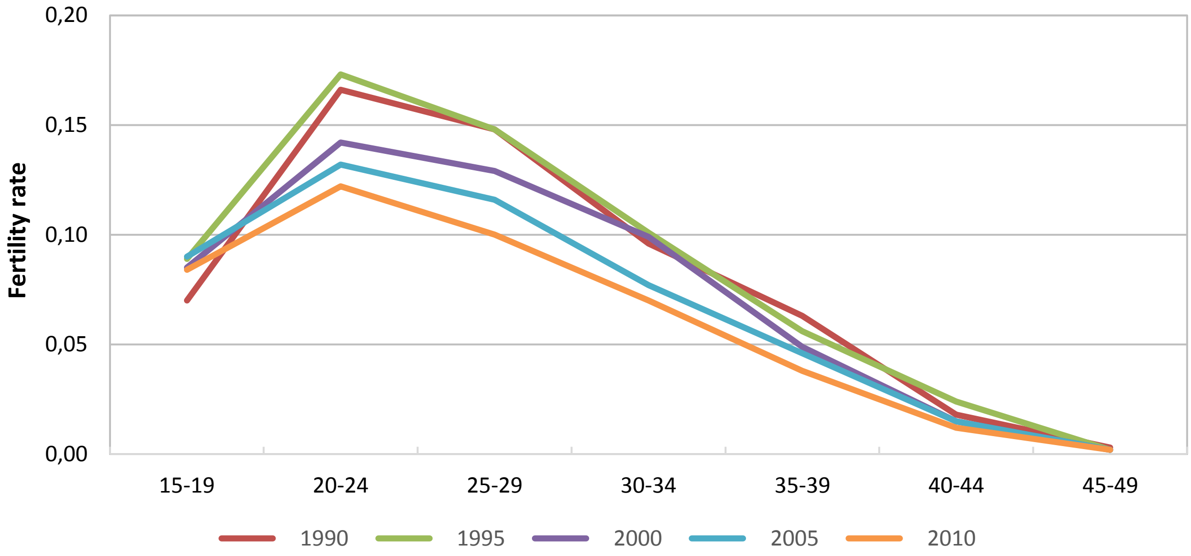
<u>Period and cohort age-specific fertility</u>

The period age-specific fertility rates plots presented in the *Graph 2* clearly show the fertility rejuvenation process in Colombia which had place throughout the Latin American countries in the 1990s. Not only did the fertility for women aged 15-19 increase between 1990 and 1995, so did the concentration of births in the youngest age groups for each consecutive period. During these 20 years the peak of the ASFR schedule remained for women in the age group 20-24.

Similar conclusions can be drawn for the *Graph 3* presenting the age-specific fertility rates for distinct birth cohorts. For cohorts born after 1970 there occured a shift in the peak of the curve depicting age-specific fertility rates to the left. Whereas the highest concentration of births for cohorts born 1960-1970 was in the age group 25-29, once women in younger cohorts reached their 30s, they were having considerably fewer children. At the same time, fertility in the age group 20-24 stayed at the unchanged level resulting in the shift of the peak of the ASFR curves. Only for the youngest cohorts of women (born 1980-1989) there is a considerable decrease in the fertility at the age of 20-24 as compared to women from older cohorts at the time they were at that age.

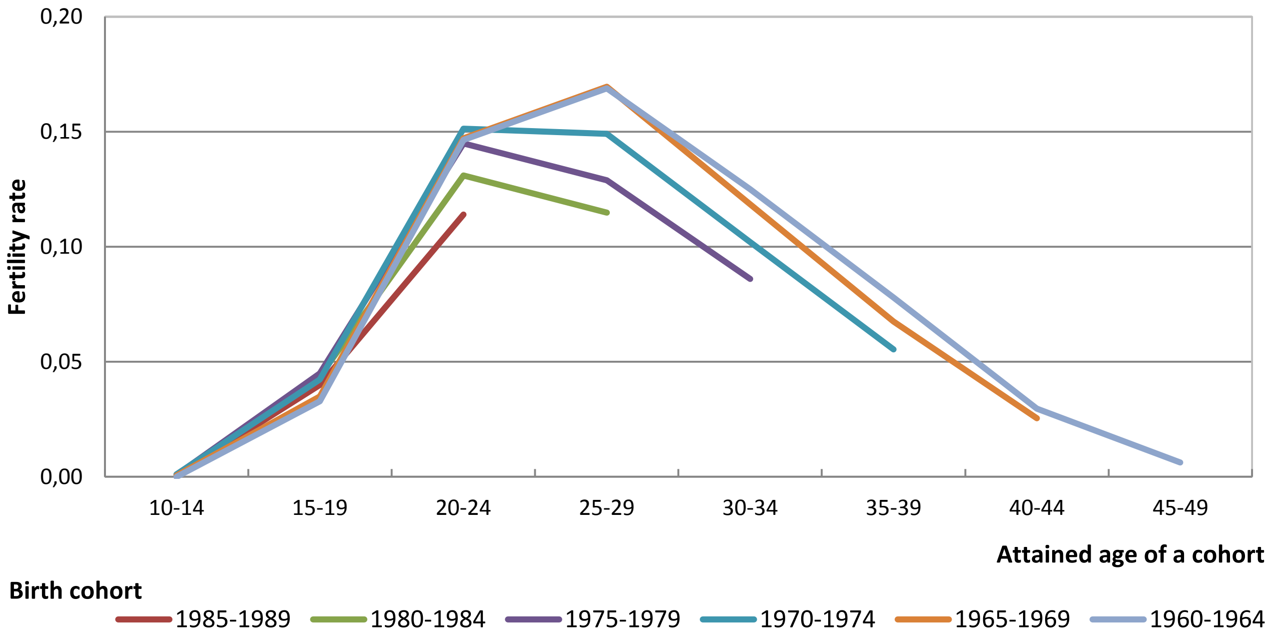
Consequently, neither the period nor the cohort ASFR schedules give any indication of birth postponement in the time period analysed, usually represented by the shift in the peak of the curve to the right. Nevertheless, the marked decrease in fertility for younger cohorts of women in their 20s suggests a change to the ASFR schedule pattern observed so far in Colombia.

Graph 2: Period age-specific fertility rates for 3 years preceding the survey, Colombia 1986-2010



Source: StatCompiler

Graph 3: Cohort-period age-specific fertility rates, Colombia

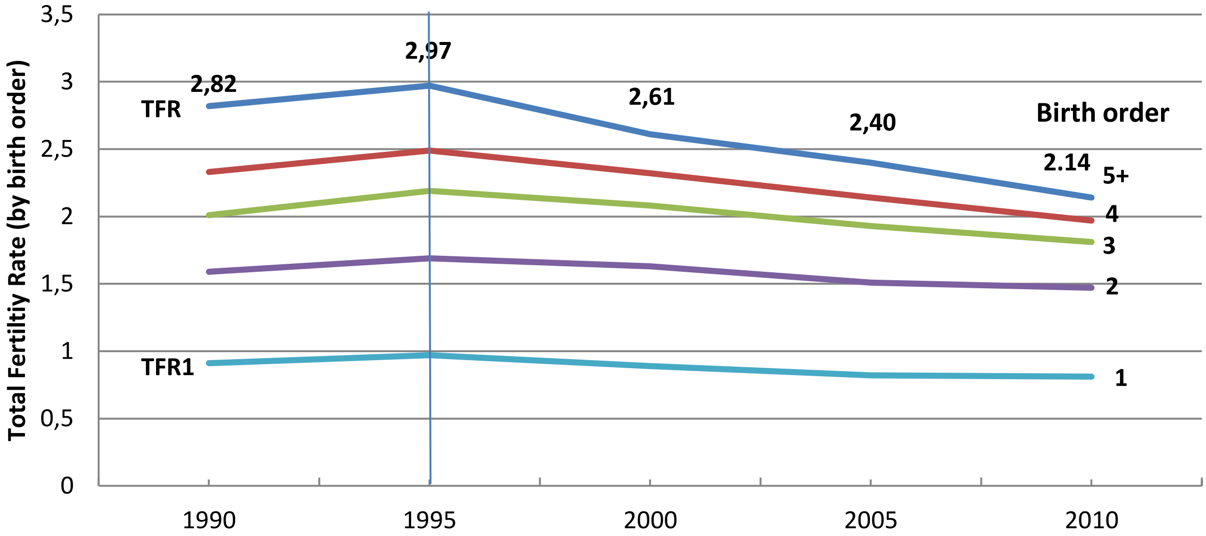


Source: Authors calculations from individual datasets

Order-specific births

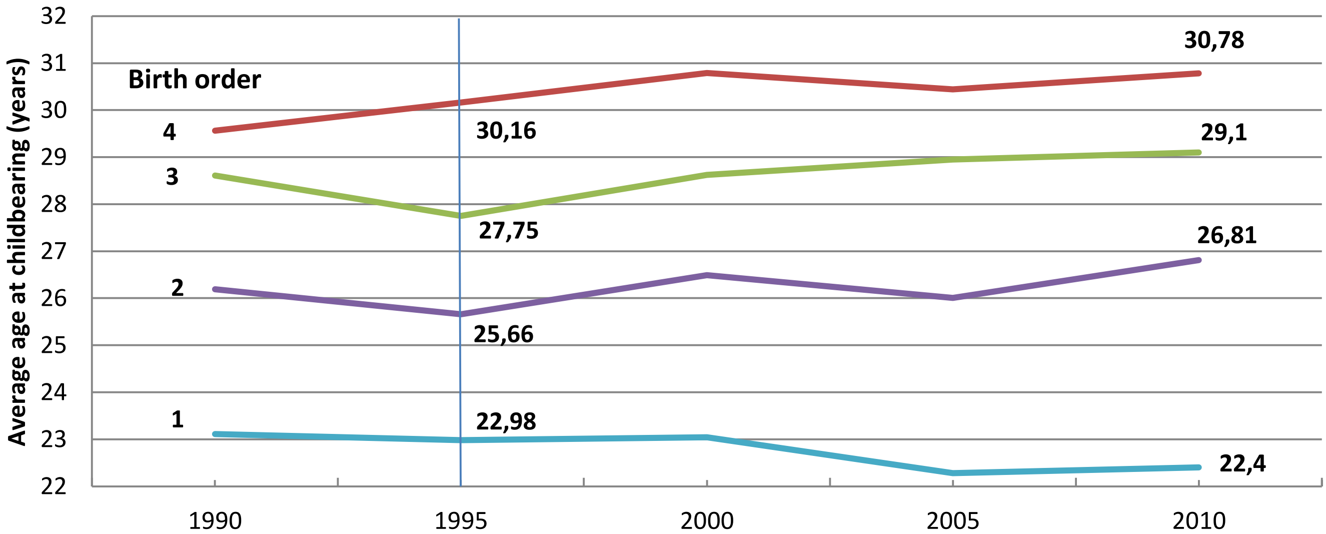
The reading of the trends in TFR and its birth order components presented in the *Graph 4* reveals that the TFR decrease in the last 20 years in Colombia, although interrupted in year 1995, was almost entirely due to the decreases in the fertility of the highest birth orders (3, 4 and 5+ children). The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

Graph 4: Total fertility rate by birth order, Colombia 1990-2010



Source: Authors calculations from individual datasets

Graph 5: Mean age at birth by parity, Colombia 1990-2010



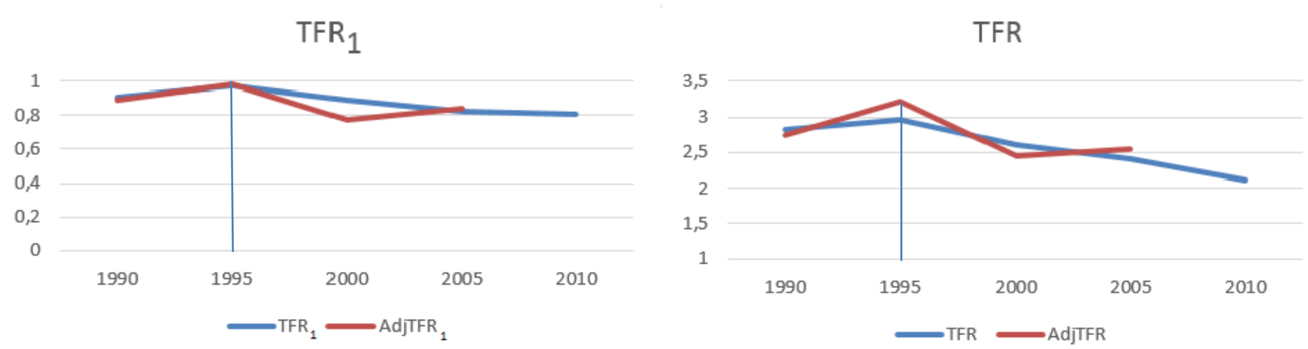
Source: Authors calculation from individual datasets

The *Graph 5* contributes to the explanation of the observed initial increase and, subsequent decrease in TFR in the period analysed. The decrease in the mean age at lower parity births between 1990 and 1995 resulted in the 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 the level even lower than observed in 1995, opposite change occurred for the higher order births, suggesting a presence of the 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 kept having their first child at an early age, at times advancing the transition to motherhood, however postponing transition to subsequent births. Considering the results presented in the *Graph 4* and *5* it appears that the feature of fertility pattern in Colombia since 1995 was having fewer children and having children of higher parity later, but starting childbearing early in life.

<u>The tempo-adjusted order-specific total fertility rates</u>

Graph 6: Total fertility rate (TFR) and tempo-adjusted total fertility rate (adjTFR), Colombia 1990 - 2010



Source: Authors calculation from individual datasets

The *Graph 6* allows for further investigation of the levels and timing of fertility at parity one and total fertility rate. Since the year 1995 there occurred 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 $AdjTFR_1$ line being situated below the TFR_1 in the year 2000. After the year 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 no tempo inhibiting effect of the first births to the observed TFR decrease.

These changes are reflected on the graph of the trend in the TFR of all parities. The advancement of childbearing produced the fertility level that would have been lower had the mean age not decreased in year 2000. In the consecutive period, however, the adjusted TFR turned out to be higher than the observed TFR marking the end of the fertility inflating effect of earlier childbearing observed in the previous years. Interestingly, in the periods in which the age at first birth was stable (where TFR_1=$AdjTFR_1$ in year 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 rather towards increasing fertility whereas those of the higher orders births, towards decreasing it. Since the year 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 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 measure. 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 the fertility changes (Bongaarts 1999). In this study, non-negligible fluctuations in the mean age at birth by parity exist and, therefore, the results should be interpreted with caution. The particularly surprising divergent trends in the mean age at first and second birth is therefore further explored through the analysis of the risk of transition to first and second birth using the event history analysis.

5.2. TIMING OF CHILDBEARING AND ITS DETERMINANTS

Table 1: Discrete-time logit models: age 10 to first birth (I), first birth to second birth (II)[4]

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: Authors calculation from individual dataset (DHS 2010)

[4] 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, the result consistent with the previous findings (see *Section 4.1*). This trend however came to a halt with cohorts born in 1975-79 and the results suggest that women born after 1985 delayed the 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 the increasing interval between the first and the second child, 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, a finding is in line with the results presented in the *Graph 5* which revealed the trend towards increasing mean age at second birth without the change, or at times decreasing mean age at the first birth. This result is obtained while controlling for the age at first birth meaning that in each consecutive cohort, women were postponing the transition to the second birth.

The education level appears to be the strongest determinants of timing of childbearing, inversely related to the risk of first, as well as second birth, among women of reproductive age. 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 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 comparing with urban residents. Moreover, women living in Central and Pacifica regions seem to be at lower risk of having a first, as well as the second child when compared to Bogota, with the opposite direction of the association 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.

5.3. TIMING OF CHILBEARING AND EDUCATION LEVEL

5.3.1. Transition to first birth

Two models with 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: Authors 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 (the reference group). This means that the relationship between the risk of first birth and birth cohort has been different with regard to 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 fit by changing the reference category of education variable. Results are presented in the *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: Authors calculation from individual dataset (DHS 2010)

The results reveal that for women with no education, the risk of first birth has not been changing between the birth cohorts for neither of the cohort groups analysed. The changes described for women with no education are in no case statistically significant and the estimates have a 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 occurred a shift in the trend of the risk of first birth, with older cohorts exhibiting an increasing risk of first birth and younger cohort showing 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 kept having their 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.

5.3.2. Transition to second birth

In the similar manner as above, 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. No distinction has been made between the two groups of cohorts as in the case of first births, because no change in the trend between the cohorts has been identified in the model (II). Results in the *Table 4* show statistically significant interaction term between the year of birth and educational level, indicating to 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: Authors 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 e.g. 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, trend in the same direction could have been observed for all educational groups.

6. DISCUSSION

The presented study provides an analysis of the changes in the fertility and the timing of childbearing in Colombia. This country experienced a rapid fertility decline in the last half century, entering a final stage of the fertility transition in recent years. This analysis demonstrated that fertility decline in the country since 1995 occurred in spite of the fertility inflating tempo change of first births. Nevertheless, the evidence of a halt to the trend towards earlier childbearing among younger cohorts of women 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 a major concern in recent years (Florez and Nunez 2002). In spite of the fact that the age at first birth in Colombia is still low, this study demonstrated a changing pattern of the timing of childbearing in the country where norms relating to later motherhood has not only emerged among women attending university, but are also spreading to lower educational groups. Finally, for younger cohorts, among none of the subgroups analysed women are advancing the entrance into parenthood.

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 the educational groups in Colombia. This will have implications for the future changes in the timing of childbearing on the population level in the country. 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 on the population level in Colombia is highly plausible in the coming years. The period fertility indicators are likely, therefore, to fall there to the below replacement level. The extent to which the observed shift in the timing of transition to motherhood will affect the TFR will be possible to examine by looking at the 2015 DHS. Nevertheless, considering that once the postponement transition is initiated, it usually continuous (Kohler, Billari and Ortega 2002), the increase in the mean age at first birth in Colombia could be expected. 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. The 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 spacing first and second birth, even after controlling for the age at first birth. This occurred without a similar process between parity 0 and 1. Moreover, although most pronounced among highly educated women, the decreased risk of transition to second birth has been prevalent across all educational groups. These results enhance the knowledge about the fertility changes in countries which are in the final stages of fertility transition, where, although changing, norms favouring early motherhood have long prevailed. The findings from Colombia does not seem to 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 the corresponding sufficient uptake of contraception was seen as a reason for increased fertility at younger ages throughout the 1990s (Ali, Cleland and Shah 2003). Moreover, the dominance of sterilization in the contraceptive mix was often considered as a reason for the reduced birth spacing, accompanied by the reduction of fertility at higher parities (Bonneuil and Medina 2009). Given the presented findings, 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 in life. In general little is known about the women`s choices of the contraceptive methods by parity in Colombia, which could cast light on the 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 trends in region. The extensive research has been conducted aiming at analysing the transition to first birth in Latin America, however, the childbearing pathways after transition to first birth are a largely unexplored topic. Currently, there is scarcity of studies on this issue in the Latin American context. 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 the replacement.

The presented analysis has its limitations. First of all the study did not incorporate the analysis of the relationship between the 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 the similar changes in the 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 Methods section, 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 throughout the literature. The joint analysis of the TFR, fertility by parity and adjusted TFR together with other methods such as event history analysis used in this study did, nevertheless, deepened the understanding of fertility changes in Colombia. The results of this study should however be interpreted taking into account these limitation.

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