Fertility transition in Latin America: Stopping patterns in selected countries

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Introduction

There are many marks that make the onset of fertility transition in Latin America be so fascinating to study. First, it is very different from Europe fertility transition. Second, surprisingly the transition from higher to lower rates happened in such a short time. Third, the decline occurred first among women in older age-groups of the reproductive range, characterizing as an option to limit their family sizes. Forth, the delay of marriages and, consequently, delay of the first childbirth were not important due the fact that it did not happen. The weddings kept happening in younger ages and as first pregnancies. And fifth, the beginning of this period coincided with the diffusion of modern contraceptive methods.

Despite the tentative of summarize some Latin America fertility transition features, it is important to consider that amongst and within countries, there are many differences. Each country has its particularities considering history, culture, economy, social and demographic characteristics. All these variances impacted the transition of fertility and make it happened through distinct processes and moments. Uruguay and Argentina (Nathan & Pardo 2016) are known as forerunners because transition started first in these countries. Moreover, Brazil, Chile, Mexico, and Colombia, for example, representing the group of countries in the intermediate stage. Finally, there is the last group, formed by countries in the beginning of the fertility transition, for example, Ecuador, Peru, Bolivia, and Paraguay (Gúzman et al. 1996; Schkolnik 2004; Rosero-Bixby et al. 2009; Lima et al. 2017). Although this division, Lima et. al (2017) stated that recently Brazil, Chile,

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Colombia, Uruguay, Costa Rica, and El Salvador are experiencing total fertility rates (TFR) below replacement.

Some fertility transition features can be fit in stopping, spacing and postponement patterns. The first is observed when a couple decided to adopt new comportments with the aim to avoid more children. Moreover, the second consists in birth intervals length changes, and the last, but not least important, is affected by transformations in the mean age at first childbearing. Together, those behaviors impact the changes in fertility, however, they do not act in the same intensity, and, depends on the determinants of fertility also.

In Europe, the postponement and spacing of births were important for the beginning of the decline. Therefore, in the most of Latin America countries, the stopping patterns affected, in the first place, the onset of fertility transition. According to Knodel (1977) the stopping behavior is adopted, for a couple, when they achieve the desired family size. In his paper about family limitation in centuries 18th and 19th, Knodel detected a decreasing in mean age at last birth.

Back in that time, between 1970 and 1980, the sterilization rates were high among women in reproductive age. Leite et al. (2004) demonstrated sterilization rates of 40,1%, 25.7%, and 40.9% for Brazil, Colombia, and Dominican Republic, respectively, between 1995 and 1996 using DHS data. All those choices confirmed how limitation of the family size is an important factor of the process of fertility decline in Latin America (Guzman et al. 1996).

Following those ideas and theories about Latin America Fertility transition, this work intends to comprehend the differences and similarities in selected countries focusing in “stopping patterns”. How there are changing and how they interact with spacing and postponement. Yet, we are also going to compare groups within countries based on education attainment and place of residence, urban or rural. Another aim behind this paper is to demonstrate another way to explore census data and fill the intercensal gap. Usually, the majority of studies about birth histories uses the DHS surveys, which have small samples and it is not available to many nations. Furthermore, the analyses using Parity Progression Rates (PPR) and the Mean Age at First Birth (MAFB) were made using the reconstructed birth histories based on censuses of Brazil, Chile, Colombia, Ecuador, Mexico, Peru, and Uruguay.

So, we would like to understand the stopping decision in those countries and also, to contribute with more findings and hypothesis about changes in fertility's behavior in Latin America region for the last decades. (Insert a paragraph about the results as well).

Background

Fertility is one of the most important Demographic Transition Components and its main characteristics are changes from a scenario with higher fertility rates to lower ones. Of course, those transformations did not happen at the same moment and path for all regions of the world. In each place the determinants of fertility (Bongaarts 1978), affected by adopted behaviors, impacting the fertility rates during the past centuries.

The first signs of decline were detected in Europe, most precisely in the Northeast, after the decline of mortality, between the end of 18th century and beginning of 19th. The pace was slowly until achieve lower rates, and the patterns that guided the transformations were pretty different from those impacting developing areas (Bongaarts 1978; Davis 1963; Davis and Blake 1956; Knodel 1987; Watkins 1990). Yet, the fertility's transition pacing in developing countries from Asia, and Latin America, surprisingly, it has been happening in an accelerated speed as was pointed by Wong (2009). Thus, Guzman et al. (1996) emphasized that Latin America fertility transition had unique features. For this reason, the transition of fertility in these areas has been instigating researchers to understand changes in women's behaviors and their role in all this process.

Transformations in Latin America fertility have been happened since 1960's. Surprisingly the region did not follow the expected patterns while couples adopted new values and reproductive behaviors related to having children and the desired family size and coincide with. However, those were not altered in the same way and time in all Latin America, which can be divided in blocks: forerunners, intermediate, and beginners. Argentina and Uruguay have started their transition earlier, around 1920 and in 1950 their fertility rates reached 3.0 children per woman. Cuba is also a particular case, because its fertility was lower in 1950's, while in most of countries it was more than 5.0, sometimes 7.0. In addition, Chile's fertility rate started to decrease in 1950, but achieved in 1970's 3 children per woman. In the meanwhile, fertility decline had just started in 1960's for countries like Brazil, Chile, Colombia, and Mexico.

Those group divisions reaffirm what Davis and Blake (1956) point of view suggested about how variation in cultural, social, economy and history can impact intermediate variables and how them affect fertility's determinants. In each country, exposure to intercourse and, consequently, conception will depend of formation and dissolution of marriages and abstinence within and out unions. Also, fecundity's levels, contraceptive practices, and, rates of involuntary and voluntary abortion are going to influencing successful pregnancies. All those interactions and choices made by women explain the diversification in the onset and paths of fertility transition in different regions and countries.

Several studies along these years (Guzmán et al. 1996; Martin and Juarez 1995; Parrado 2000; Chackiel and Schkolnik 2003; Wong 2009; Rosero-Bixby et al. 2009; Casterline and Odden 2016; Lima et al. 2017) enumerated remarkable factors about the short term fertility decline. The transition's onset coincided with the spread of modern contraceptives and their diffusion, development and distribution. However, in several countries, abortion and sterilization were a common choice among women. In addition, changes in marriage age were not crucial as in other places, since people kept getting married in young age. There is, also, the boom of cohabitation, a feature very particular from Latin America, where couples stay together for several years and build families without make the relationship official in front of law (Esteve, Lesthaegue, and López-Gay 2012).

Transformations in social and economic structures contributed to change some values among couples and women. The increase in urbanization, migration from rural to urban centers, women's insertion in labor market, and the raise of education attainment were important and have been impacting women's decisions about having children, how many and when. Therefore, over all those years some of them are impact more, some not so much. Recently, Rios-Neto et al. (2018)

Fertility transition can also be analyze based in some patterns adopted by women, which are called stopping, spacing, and postponement behaviors. Many historic demographers as Knodel (1977, 1987) and Van Bavel (2004) tried to understand those patterns previously in Europe. According to them, birth stopping consists in women or couples'

desire of avoiding having more children. Anderton and Bean (1985) listed two evidences in European cohorts: the decrease in the age at last birth, and also, the decline in final parity in older age groups. Furthermore, spacing comprehend changings in intervals births length which can be affected by several determinants as breastfeeding and abortion in the past centuries, but now is influenced by contraceptives use too. Final parity it will be influenced by how long those intervals are. Finally, postponement, another observed pattern, it is understood as the delay of childbearing, manifested by the increase of mean age at first child. This behavior impacts the initial exposition of women to the risk of childbearing that before it used to be predicted with age at first marriage. However, with the emergence of new values and modern contraceptive methods the beginning of sexual exposure is not exclusively linked to the matrimony anymore.

Also, the spread of modern contraceptives coincides with the fertility decline due to diffusion, development and distribution of them. Although these facts, abortion is pretty
Increase in educational, occupational, social, and geographical mobility brought new values. All of that caused, in a way, reduction of labor spots in rural areas, increase of no artisanal positions and increase in women's participation in labor force.
In the onset of fertility decline there was some populations sectors that already were practicing birth control. Urban x Rural; High income x low income.
High fertility was related to a reproductive logic which was connected to social and economic characteristics in that previous context. Rural families with needs for many workers.
Structural changes from traditional sectors resulted on family size control.
Social and economic changes in Latin America improved social group's integrations and also the desire around achieve a better life quality, better social position.
Reduction of child and infant mortality impact children's survivor. Due this, parents started to invest in their kids to achieve a better life pattern.
Education as path to social transformation.
Education plus expectations acquired and developed explain how fast couples and women from low social economic status adopted and absorbed new attitudes and values.
Middle class as model to social mobility.

Immigration to urban areas also affected the speed of social transformations and consequently the drop on fertility. It helped to deepen the interaction among rural and urban by spreading ideas and behavior related to fertility control.

According to Guzman et al (1996) fertility decline intensity was determined by the speed which the different groups and sector integrated during the process. Changes process are not linear, but pretty irregular. Those irregularities did not depend only of innovation's emergence, but also of how the adoption of new practices impacted on the new ideal of family.

For some authors (Rosero-Bixby et al. 2009; Wong 2009; Lima et al. 2017), the decline of TFR in Latin America and East Asia are similar in rhythm, however, in the second, the age-specific fertility rates have been declining between younger women. As what happened in Europe, in East Asia the mean age at first child (MAFB) increased due to marriage delay, also characterizing postponement behavior (Kohler and Ortega 2002; Yu-Hua 2012). Nonetheless, Latin American women maintained their mean age at marriage and their first childbearing constant and younger for the past decades. Otherwise, women from older age groups, 35 to 49, started to have fewer children and opting for limiting their family sizes. In the other words, they were reducing their parity progression rates to superior birth orders. This type of behavior can be defined as "stopping", which, according to Knodel (1977) "stopping" consisted in adopted behaviors by couples or individuals when they achieve the desired family size. In his paper about family limitation in centuries 18th and 19th, Knodel detected a decreasing in mean age at last birth.

Therefore, Lima et. al.(2017) enumerated three characteristics and reasons to explain transformations in fertility timing that have been influencing low fertility in those countries based on literature. They are: recent tendency in forming a family later, the high and persistent fertility among teenagers and what they identify as reproductive polarization caused by education.

Methods

1.1 Birth History Reconstruction Method

The first step of the methodology consists on elaborating the database, applying the Birth History Reconstruction Method (Luther and Cho 1988) at the demographic census data

of selected countries (Table 1). All censuses data available came from the Integrated Public Use Microdata Series – International (IPUMS-International). [3] The choose data from IPUMS is due to their harmonization and also for the fact that all the data was provided from the same source and passed for the same processes.

The Birth History Reconstruction Method (Luther and Cho 1988) is an extension of the Own Children Method and allow us to calculate birth intervals and parity progression based on the complete birth histories extracted from questionnaires about fertility obtained from census data. One of the assumptions of this method is that children aged fourteen years old or less are still living with their mothers. In other words, when this method is applied, we can go back in time for fourteen years from the census's reference date.

Table 1: Selected countries to apply the Birth Histories Reconstruction Method

Countries	**Year**
Brazil	2010, 2000 and 1991
Chile	2002, 1992 and 1982
Uruguay	2011 and 1996
Mexico	2015 and 2000
Peru	2007 and 1993
Colombia	2005 and 1993
Ecuador	2010 and 2001

In addition, the BHRM allow us to allocate a mother and their children based in kinship relationships. This is possible because IPUMS data provides a variable named MOMLOC, which shows the place of mother in household. And also another variable PERNUM, which each family member received an identification.

The first step of the method is creating a variable which is going to be the key of our linkage process. For this data we use an interaction between the serial number and the variable PERNUM. After that it is necessary to separate and produce a potential mothers' dataset, which means, women between 15 and 64 years old. Following, another database

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must to be generated and it will contain potential children with 14 years old or less. To this base two new variables will be creating: NPERSON, an interaction between serial number and the PERNUM, and, a KEY, provided for the fusion of the serial number and the MOMLOC. It is worth it to emphasize that the variable KEY it is crucial to connect mothers and children.

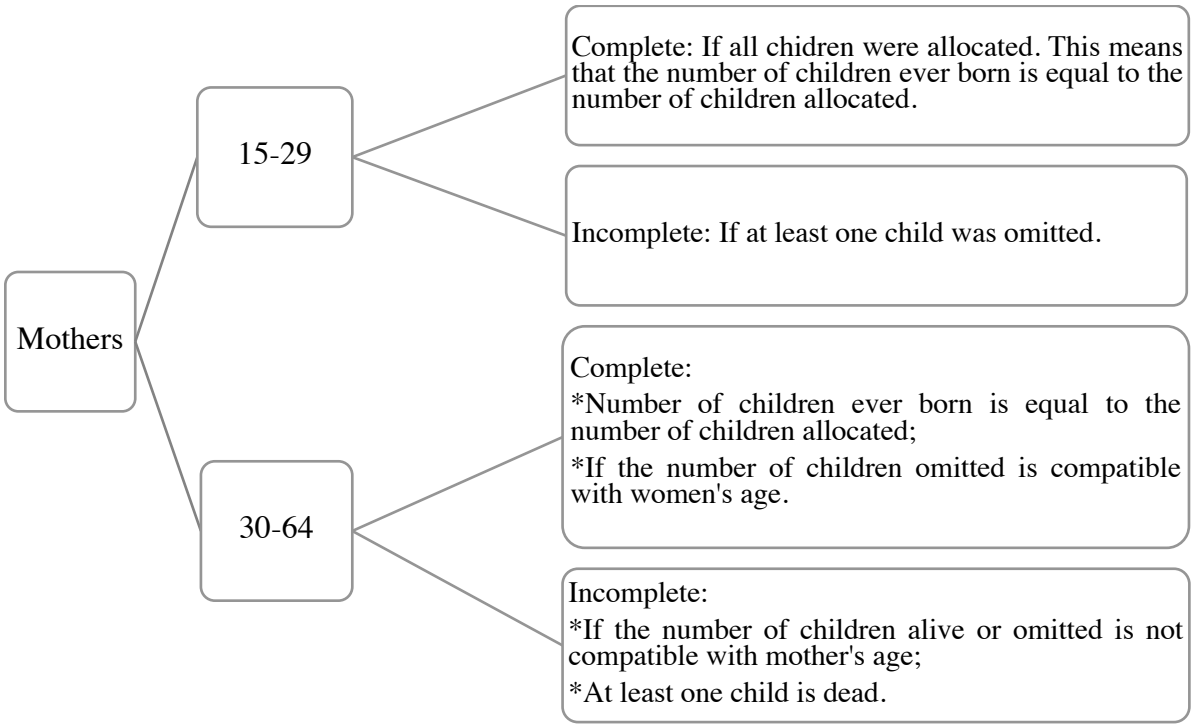
With these two datasets ready it is time to merge them using the KEY variable. Also, it will be possible to create fourteen new variables that will based on children age and that will refer to the birth in the last year during the fourteen years before. After that we have to aggregate the new database according to the KEY.

The next step is one of the most important because it is going to determinate which birth histories are complete or not. Also, it is going to be related to mother's age which is it is going to be used to divide women in two groups: thirty years old or more and less than thirty.

Among women with twenty-nine and less, that we consider that started their reproductive interval at fifteen, we assume that all kids they had should be living with them. So, if the number of children allocated to a woman is lower than the number of children ever born that she declared, her history will be classified as partial. On the other hand, if the number of children ever born and the number of children allocated are the same, the history will be complete.

However, for women with thirty and more the analysis is going to be different because they can have sons and daughters living outside their households. For this reason, the decision if their birth histories are complete or not will depend of the number of children ever born and if it is compatible with their age. Furthermore, the Diagram 1 bellow is explaining the decision-make process.

Diagram 1: Decision process of complete or incomplete birth histories



Source: Adapted from Miranda-ribeiro, Rios-Neto and Carvalho (2009)

After determining the type of histories, the dataset should be separated in two: one with complete histories and another with incomplete. Those two will be important to the next step, which is going to be the matching process to transform partial histories into complete histories.

To execute the matching, we have chosen the Record Linkage Package [4]to execute using R. Also, it is going to be necessary to define blocking variables and their weights, which are going to be responsible to compare women's characteristics, find the most perfect match, and then linkage histories based in scores. Moreover, to connect these histories and produce scores the method of linkage selected to estimate scores is the Jaro-Winkler [5]algorithm. As higher the score is, more similarities were found. So, if all variables were exactly the same the score is 1. On the other hand, if anyone match the score is 0.

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[4] Andreas Borg and Murat Sariyar (2016). RecordLinkage: Record Linkage in R. R package version 0.4-10. https://CRAN.R-project.org/package=RecordLinkage

[5] Winkler, W. E. (1990). String Comparator Metrics and Enhanced Decision Rules in the Fellegi-Sunter Model of Record Linkage.

This stage is important because consider some existing heterogeneities in the fertility transition within countries. In the case of Latin America countries selected, we choose as blocking variables and their weights: geographic location (10%), age (25%), children ever born (25%), the education attainment (20%), the employment status (10%), and the marriage status (10%).

Then, after to create the pairs, based on the best scores, it will be inputted the incomplete histories with characteristics from women in the complete histories database. At that time, we are going to produce the final dataset with all women and their fertility information for each country selected. These datasets are going to be the base of this work because all future steps will be executed with them.

Fertility measures

After all database were process it is essential to know more about them by using classical fertility measures. Also, some of them will give to us a first look on the process that we are interested about.

- Total Fertility Rate (TFR): It is a period measure of the average number of children per women if they achieve the end of reproductive interval under the fertility's schedule of that year.
- Complete fertility of cohort:
- SMAFB (Single mean age at First Birth):

$$ {}_5\Pi_x = \frac{{}_5W_x^{i=0}}{{}_5W_x} $$

$$ \Pi(50) = \frac{{}_5\Pi_{45} + {}_5\Pi_{50}}{2} $$

$$ SMAFB = \frac{\left(n.\sum_{x=0}^{45} {}_5\Pi_x\right) - \left(50 * \left(\Pi(50)\right)\right)}{1 - \Pi(50)} $$

Stopping Patterns

$$ PPR_{(i,i+1)} = \frac{P_{i+1}}{P_i} $$

Where P_{i+1} is the number of women with parity i+1 and P_i is the number of women with parity i. Probability of a woman achieve P(i+1).

$$PPR_{(0,i)} = \frac{P_i}{P_0} = \frac{B_i}{W}$$

$$TFR = \sum_{i=1}^{n} PPR_{(0,1)}$$

or

Results (Will be update until April 6th)

The birth histories reconstruction method already was applied for Uruguay and Colombia censuses data. Then, for the future paper the method will be applied to other countries and go back for 28 years. Next, we present charts with Total Fertility Rates (TFR) and the birth orders according with education. We also intend to understand how employment status and marriage impact.

Furthermore, analyzing the charts below we can see that there are differences between Uruguay and Colombia. Also, the TFR, in both countries show different behaviors and for Uruguay the process of convergence is ahead. The behavior of women with superior education in Uruguay used to be higher before 2000 and it is something to investigate.

About the birth order, we can observe that the participation of first births is getting higher according with education. However, births of third order are higher among women with primary education.

Chart 1:Total Fertility Rate for Colombia – Total and according to Education

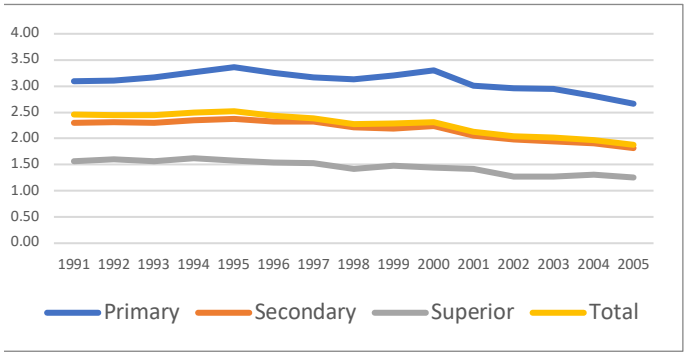
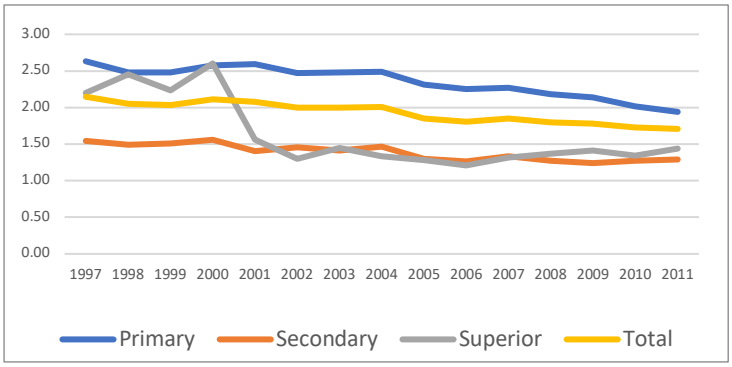


Chart 2: Total Fertility Rate for Uruguay – Total and according to Education



Source: Elaborated by Authors based on IPUMS data

Chart 3: Birth Order for women with at least primary school - Colombia

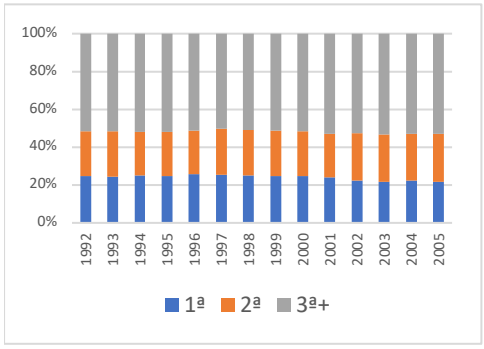


Chart 4: Birth Order for women with secondary school - Colombia

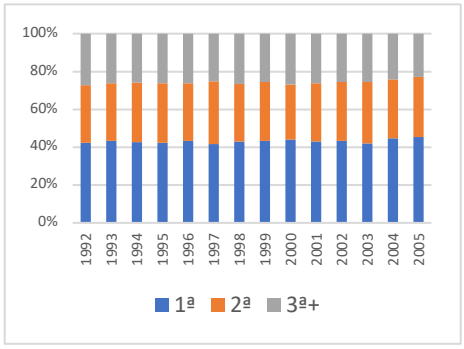
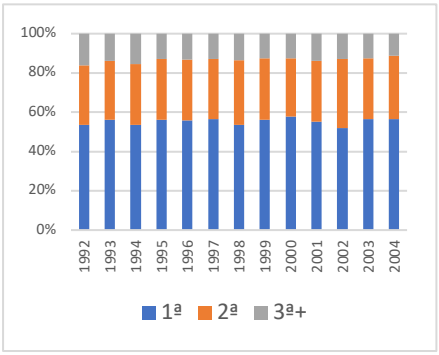


Chart 5: Birth Order for women with at least superior school - Colombia



Source: Elaborated by Authors based on IPUMS data

Chart 6 Birth Order for women with at least primary school - Uruguay

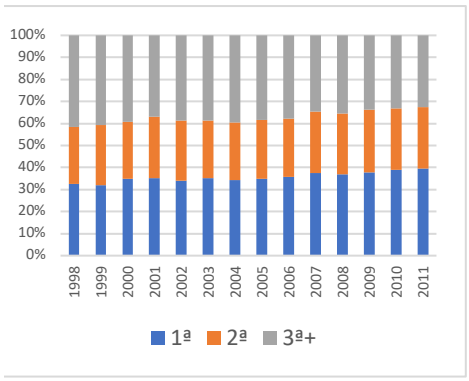


Chart 7: Birth Order for women with secondary school - Uruguay

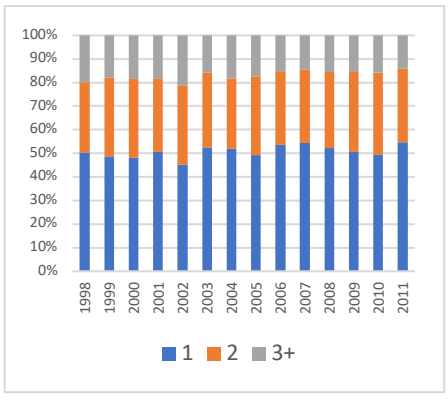
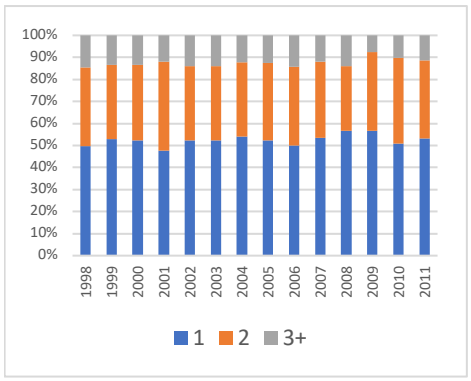


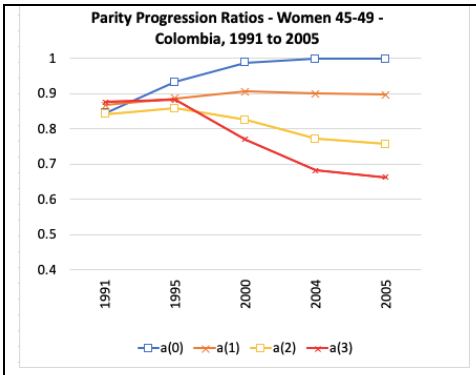
Chart 8: Birth Order for women with superior school - Uruguay

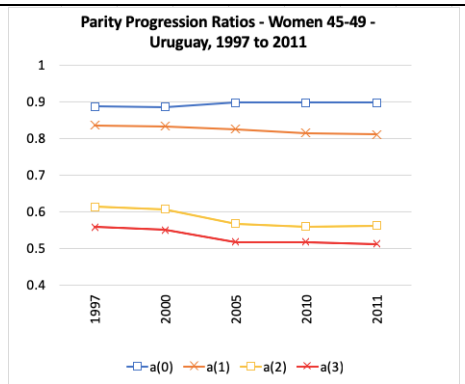


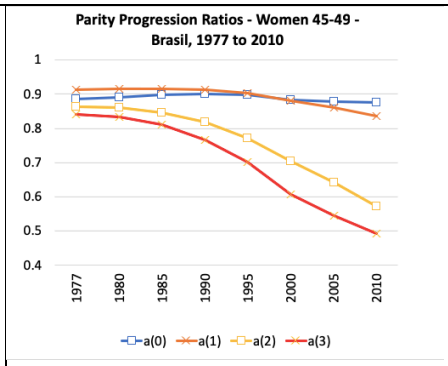
Source: Elaborated by Authors based on IPUMS data

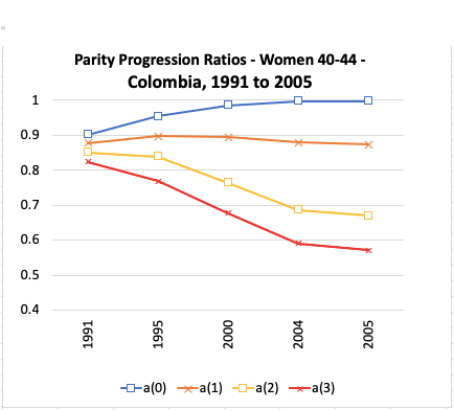
In the graphics bellow the Parity Progression Rates (PPR) can be observed along the last years for the last three age groups of the reproductive interval range. Thus, each line portraits the transition to a specific parity among different cohorts. The line a(0) : PPR from 0 to 1 child; a(1) PPR from 1 to 2 children; a(2): PPR from 2 to 3 children; and a(3): PPR from 3 to 4 children. For all years Uruguay showed a constancy while Colombia and Brazil presented important features mostly in the transition from Parity 2 to 3 and 3 to 4, among women in age groups 45 to 49 and 40 to 44. Based on this, we can infer how stopping patterns were important among the oldest cohorts.

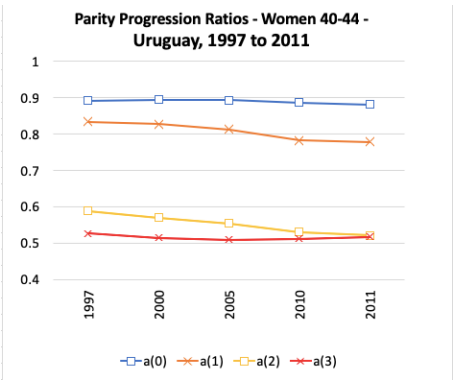
However, when those data are plotted for women between 30 and 34, it is possible to detect a considerable decline in parities from 0 to 1 and 1to 2. The first one allows us to suppose the existence of a postponement pattern, and, consequently the raise in the proportion of childless women. Therefore, the second found can be linked, not just, to the increase of only child, but also with the delay of childbearing and its impact in the final parity.

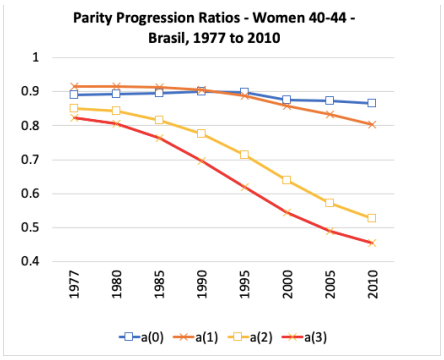


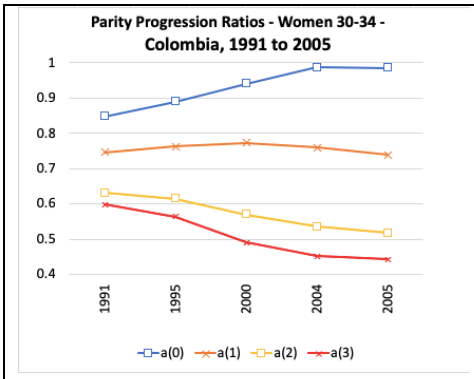


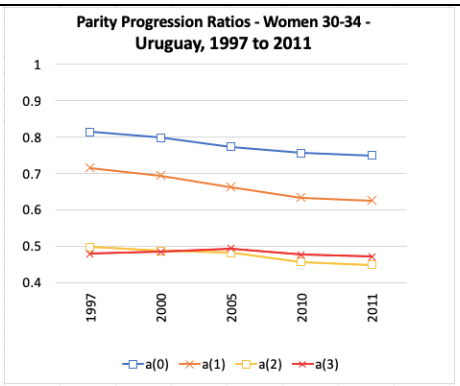


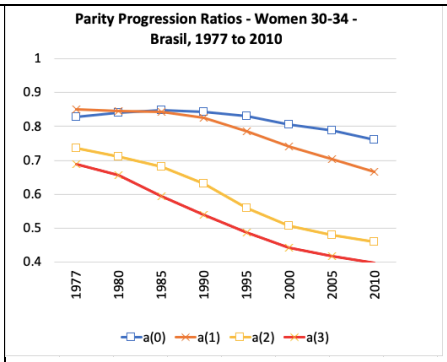












Source: Elaborated by Authors based on IPUMS data

Conclusions:

References:

Van Bavel, Jan. 2004. "Detecting Stopping and Spacing Behaviour in Historical Demography." *Population* 59(1):117–28.

Bongaarts, John. 1978. "A Framework for Analyzing the Proximate Determinants of Fertility." *Population and Development Review* 4(1):105–32.

Casterline, John B. and C. Odden. 2016. "Trends in Inter-Birth Intervals in Developing Countries 1965 – 2014." *Population and Development Review* 42(2):173–94.

Chackiel, Juan and Susana Schkolnik. 2003. *América Latina: Los Sectores Regazados En La Trasicion de La Fecundidad*. Serie Pobl. Santiago, Chile: Centro Latinoamericano y Caribeño de Demografía (CELADE) - Division de Poblacion.

Davis, K. 1963. "The Theory of Change and Response in Modern Demographic History." *Office Of Population Research* 29(4):345–66.

Davis, K. and J. Blake. 1956. "Social Structure and Fertility: An Analytic Framework." *Economic Development and Cultural Change* 4(3):211–35.

Esteve, Albert, Ron Lesthaegue, and Antonio López-Gay. 2012. “The Latin American Cohabitation Boom ,.” *Population and Development Review* 38(1):55–81.

Guzmán, J. M., S. Singh, G. Rodríguez, and E. A. Pantelides, eds. 1996. *The Fertility Transition in Latin America*. 1ª. New York: Oxford University Press.

Gúzman, J. M., S. Susheela, G. Rodríguez, and E. A. Pantelides. 1996. *The Fertility Transition in Latin America*. Oxford: Claridon Press.

Knodel, J. 1977. “Family Limitation and the Fertility Transition: Evidence from the Age Patterns of Fertility in Europe and Asia.” *Population Studies* 31(2):219–49.

Knodel, J. 1987. “Starting, Stopping, and Spacing during the Early Stages of Fertility Transition: The Experience of German Village Populations in the 18th and 19th Centuries.” *Demography* 24(2):143–62.

Kohler, Hans Peter and Jos?? Antonio Ortega. 2002. “Tempo-Adjusted Period Parity Progression Measures, Fertility Postponement and Completed Cohort Fertility.” *Demographic Research* 6:91–136.

Lima, Everton, Kystof Zeman, Matias Nathan, Ruben Castro, and Tomáš Sobotka. 2017. *Twin Peaks: The Emergence of Bimodal Fertility Profiles in Latin America*.

Luther, Norman Y. and Lee-Jay Cho. 1988. “Reconstruction of Birth Histories from Census and Household Survey Data.” *Population Studies* 42(3):451–72.

Martin, Teresa Castro and Fatima Juarez. 1995. “The Impact of Women ’s Education on Fertility In Latin America : Searching for Explanations.” *International Family Planning Perspectives* 21(2):52–57.

Miranda-ribeiro, A., E. Rios-Neto, and J. A. M. Carvalho. 2009. “Reconstrução de Histórias de Nascimentos a Partir de Dados Censitários: Uma Análise Comparativa de Duas Metodologias.” *Revista Brasileira de Estudos Populacionais* 26(1):21–35.

Parrado, Emilio Alberto. 2000. “Social Change, Population Policies, and Fertility Decline in Colombia and Venezuela.” *Population Research and Policy Review* 19:421–57.

Rios-Neto, Eduardo, Adriana De Miranda-Ribeiro, and Paula de Miranda-Ribeiro. 2018. “Fertility Differencials by Education in Brazil : From the Conclusion of Fertility to the Onset.” *Population and Development Review* 0(0):1–29.

Rosero-Bixby, Luis, Teresa Castro-Martín, and Teresa Martín-García. 2009. “Is Latin America Starting to Retreat from Early and Universal Childbearing?” *Demographic Research* 20:169–94.

Schkolnik, Susana. 2004. “La Fecundidad En América Latina.” Pp. 33–48 in *La fecundidad en América Latina: ¿Transición o revolución?* Santiago do Chile: CELADE - Division de Población CEPAL.

Yu-Hua, Chen. 2012. “Trends in Low Fertility and Policy Responses in Taiwan.” *The Japanese Journal of Population* 10(1):78–88.