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EL ROL DE LOS ESTUDIOS DE POBLACIÓN TRAS LA PANDEMIA DE COVID-19 Y EL DESAFÍO DE LA IGUALDAD EN AMÉRICA LATINA Y EL CARIBE

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Trends in Latin America Fertility Transition: A study based on synthetic cohorts and lifetime probabilities

Trends in Latin America Fertility Transition: A study based on synthetic cohorts and life-time probabilities

Many marks make the onset of fertility transition in Latin America fascinating to study. First, it is very different from European features. Second, 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. Fourth, the delay of marriages and, consequently, the delay of the first childbirth were not that important. Weddings continued to happen at younger ages as first pregnancies. And fifth, the beginning of this period coincided with the diffusion of modern contraceptive methods(Carvalho and Wong 1996; Guzmán et al. 1996; Rosero-Bixby, Castro-Martín, and Martín-García 2009; Wong 2009).

Despite the tentative of summarizing the Latin American fertility transition, 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 and 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 at the beginning of the fertility transition, for example, Ecuador, Peru, Bolivia, and Paraguay (Guzmán et al. (1996); Schkolnik@2004; Rosero-Bixby, Castro-Martín, and Martín-García (2009); Lima et al. (2017)). Although this division, Lima et al. (2018) stated that recently Brazil, Chile, Colombia, Uruguay, Costa Rica, and El Salvador are experiencing total fertility rates (TFR) below replacement.

Some fertility transition features might be fitting in stopping, spacing, and postponement patterns. The first is observed when a couple decided to adopt new comportments aiming to avoid more children. Moreover, the second consists of birth intervals changes. The last, but not least important, is affected by variations in the mean age at first childbearing. Mutually, those behaviors impact the shifts in fertility, however, they do not operate at the same intensity. Besides, they also depend on the determinants of fertility.

As we have mentioned, several studies along the past years enumerated outstanding factors concerning the short-term fertility decline in Latin American countries. Transformations in social and economic structures contributed to change some values among women (Martin 1995). Among them we have: the increase in urbanization, the intensification of migration from rural to urban centers, women's participation in the labor market, and the rise of educational attainment have been impacting women's decisions about the timing of childbearing and the desired number of

children. Furthermore, the spread of modern contraceptives coincides with the fertility decline due to diffusion, development, and distribution of them (Chackiel and Schkolnik 2003; Martin and Juarez 1995, Guzmán et al. (1996), Parrado (2000); Wong 2009, Rosero-Bixby, Castro-Martín, and Martín-García (2009), Casterline and Odden (2016), Lima et al. (2018)).

All these structural and social shifts affected directly women's decisions concerning children. Their involvement in the economy and labor market, in addition to contraceptive methods, culminated in a revolution (Goldin 2006). Employed and high educated women are likely to postpone births to pursue a career, which is indicated by the positive correlation between contraceptive methods and years of schooling (Goldin and Katz 2000; Martin 1995). Nonetheless, the proportion of childlessness women, drove by the postponement, has been growing in the developed countries (Hayford 2013; Tanturri et al. 2015).

Besides all this knowledge regarding fertility transition, one important question that emerged in the demographer's minds is concerning the future of fertility. Is it going to decline continuously? Are fertility rates going to recovery at some point? Will large families become rare? Will the proportion of childlessness grow continuously as the tempo effect increase its influence? Should we expect younger cohorts to behave differently than the older ones?

As a tentative to answer some of these questions that popped up, we intend to analyze synthetic cohorts under observed and adjusted fertility schedules for six countries in Latin America: Brazil, Chile, Colombia, Ecuador, Peru, and Uruguay. Based on reconstructed birth histories we produced synthetic cohorts using fertility tables estimating observed and postponement trends. With all data available we also aim to predict the behavior of women who have yet not finished their reproductive life.

Results derived from birth histories show a general decline in women's average final parity over the years. Also, the lifetime probabilities point to a continuous decline in the proportion of women progressing to third and fourth parities.

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, are impacting the fertility rates during the past centuries.

In Europe's case, the first signs of decline were detected, most precisely in the Northeast, after the decline of mortality, between the end of the 18th century and the beginning of the 19th century. The pace was slow until achieving lower rates, and the patterns that guided the transformations were pretty different from those impacting developing areas [Bongaarts (1978); Knodel (1987); Watkins

(1990)). Compared to Europe, the fertility transition in developing countries from Asia, and Latin America, has been happening at an accelerated pace as pointed by Wong (2009). Thus, Guzmán et al. (1996) emphasized that Latin America's fertility transition had unique features compared to other regions. 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.

Since the 1960s, the LA region has not been following the expected patterns. Couples had adopted new values and reproductive behaviors, however, they did not alter in the same way and time in all Latin America. The countries can be divided into blocks as forerunners, intermediate, and beginners. Argentina and Uruguay have started their transition earlier, around 1920 and by 1950 their fertility rates reached 3.0 children per woman. Cuba is also a particular case because its fertility was already low in the 1950s, while in most countries TFR was more than 5.0, sometimes 7.0. In addition, Chile's TFR started to decrease in 1950, however, by the 1970s, TFR was 3 children per woman. In the meanwhile, fertility decline had just started for countries like Brazil, Chile, Colombia, and Mexico (Chackiel and Schkolnik 2003).

The division reaffirms what Davis and Blake (1956) point of view suggested about how variation in the cultural, social, economy, and history can impact intermediate variables and, also, affect fertility's determinants. In each country, exposure to intercourse and, consequently, conception will depend on the formation and dissolution of marriages and abstinence within and out of unions. Also, fecundity 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 (1995); Parrado (2000); Chackiel and Schkolnik (2003); Wong (2009); Rosero-Bixby, Castro-Martín, and Martín-García (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. Besides, changes in age at marriage were not as crucial as in other places, since people are still getting married at a younger age. There is, also, the boom of cohabitation, which is a feature very particular from Latin America. It is very common among couples to remain together for several years and build families without officiating the relationship (Esteve, Lesthaegue, and López-Gay 2012).

For some authors (Rosero-Bixby et al. 2009; Wong 2009; Lima et al. 2017), the decline of TFR in Latin America and East Asia is 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 the 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 other words, they were reducing their parity progression rates to superior birth orders.

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 the labor market, and the rise of educational attainment were important and have been impacting women's decisions regarding having children, how many, and when (Cavenaghi and Alves 2009).

Also, the spread of modern contraceptives coincides with the fertility decline due to diffusion, development, and distribution of them. Although these facts, abortion, and sterilization methods were a common choice among women and extremely effective. As was detected by several researchers, the limitation of the family's size was crucial to the onset of fertility decline in LA. Between 1970 and 1980, the sterilization rates were high among women at the reproductive ages. (**???**) demonstrated sterilization rates of 40,1%, 25.7%, and 40.9% for Brazil, Colombia, and the Dominican Republic, respectively, between 1995 and 1996 using DHS data. All those choices confirmed how the limitation of family size is an important factor in the process of fertility decline (Guzmán et al. 1996).

The enlargement of education, occupational, social, and geographical mobility, in addition to transformations in economic structures, produced new values for women and their families. If before high fertility used to be necessary among rural families, around the 1960s, changes in traditional sectors promoted fertility control, and consequently, impacted their sizes. With the drop of labor spots in rural areas, followed by the increasing of no artisanal positions in metropolitan regions, rural-urban migration was intensified. According to Easterlin and Crimmins (1985), Rural-Urban Migration's intensification promoted new values and lifestyles which were anti-natal. Thus, financial needs to raise children in cities became higher than usual, since the quality of them started to be considered.

It worth highlighting that some populations sectors were practicing birth control already. Most of them were residents of metropolitan areas and from high-income families as mentioned by Carvalho and Brito (2005). However, social and economic changes in Latin America promoted the social group's integrations spreading the desire to achieve a better life quality and social status.

Access to education and, consequently, information was important for women. It provided knowledge about hygiene, care, and food, which were crucial to decrease child mortality. Also, it may change and influence views and behaviors. Improvement in education and skills allowed women to achieve and compete for better positions in the job market. As the possibilities increased, the conflict between children and career intensifies (Doepke 2015; Easterlin and Crimmins 1985; Martin 1995; Zaidi and Morgan 2017).

The revolution driven by education, employment, and the job market impacted women's decisions concerning children. Frustrated tentatives of conciliating children and work leading women to plan and think carefully about their timing to motherhood. Still, the maternity penalty also influences childbearing (Zaidi and Morgan 2017). Besides, we already witness a process of fertility aging, due to the postponement of first births, which has affected the progression rates to a third and fourth child. Further, many of these women delaying first birth might become infecundable and turn into permanent postponers (Timæus and Moultrie 2020).

The postponement is understood as the delay of childbearing, manifested by the increase of mean age at the first child. This behavior impacts the initial exposition of women to the risk of childbearing. While in the developed countries postponement is confirmed and the proportion of childlessness has been growing(Hayford 2013; Tanturri et al. 2015; Wagner et al. 2015), in Latin America studies observe traces of them. Pieces of evidence indicate the emergence of postponement trends in countries from Latin America. Lima et al. (2018) detected a bimodal behavior at the first births age-specific fertility rates (ASFR) deemed "Twin Peaks". Countries such as Brazil and Chile displayed two modal ages at fertility: 19 and 30 years old. Miranda-Ribeiro, Garcia, and Bernardes (2019), Nathan and Pardo (2019), and Batyra (2016) pointed to evidence of postponement in some groups of women in Brazil, Uruguay, and Colombia. Additionally, Rios-Neto, Miranda-Ribeiro, and Miranda-Ribeiro (2018) points to a postponement transition among highly educated women in Brazil and the possibility of an increase in childlessness women.

Methods and data

We have been working with censuses data from Brazil, Chile, Colombia, Ecuador, Peru, and Uruguay. With the available data from IPUMS we reconstructed women's birth histories by applying the Birth Histories Reconstructed Method - BHRM - (Miranda-Ribeiro, Rios-Neto, and Carvalho 2009). With this methodology, it was possible to obtain fertility measures since the 1980s. Further, we applied the KO model (Kohler and Ortega 2002) to adjust childbearing intensities $m_j(a)$, also called occurrence-exposure rates by parity j represented in the Equation 1.

$$m_j(a,t) = \frac{B_{j+1}(a,t)}{E_j(a,t)} \tag{1}$$

Where $B_{j+1}(a,t)$ is the total of births of order $j+1$ that happened among women at age a and time t. $E_j(a,t)$ is the total number of women of parity j at age a and time t. In this case, just women at risk of progressing to an additional parity must be considered.

The Equation 2 estimates the tempo effect by parity j and age a. γ_j^m and δ_j^m are the mean and variance changes in the age at a birth order j, respectively. Moreover, $\tilde{a}_j^m$ is the mean age at birth order j.

$$r_j^m(a) = \gamma_j^m + \delta_j^m \times (a - \tilde{a}_j^m) \tag{2}$$

Once we have estimated the $r_j^m(a)$ for each parity and age-group, we calculated the Adjusted childbearing intensities, as in Equation 3:

$$m'_j(a) = \frac{m_j(a)}{[1 - r_j^m(a)]} \tag{3}$$

Finally, to estimate the life-time probabilities, which indicate the probability of a woman at age x and parity j experiences a next parity $j+1$ between exact ages x and y. Since the probabilities are conditional, only those women who would eventually have the first child will be considered in the estimation of second births probabilities. The same is applied in the subsequent parities.

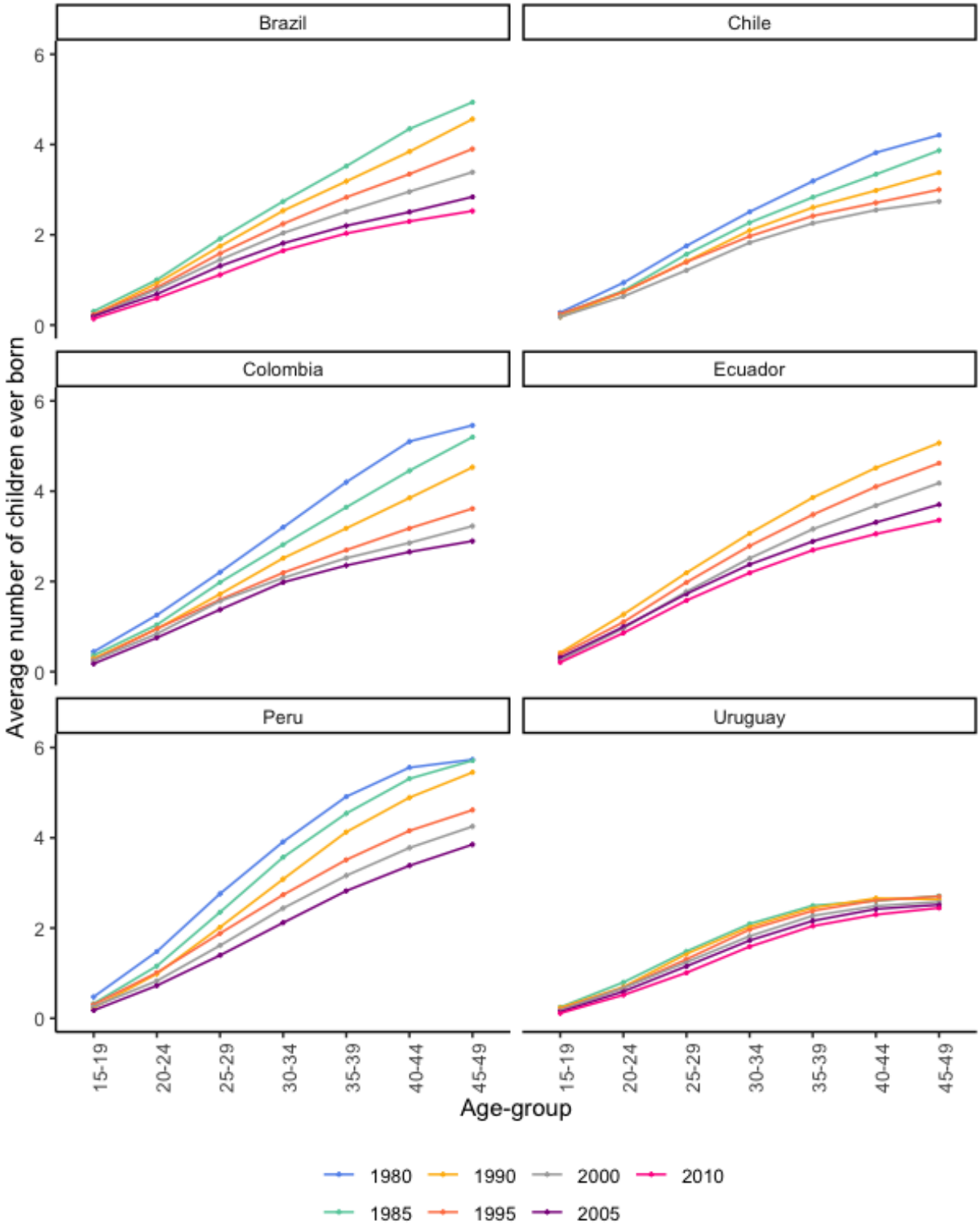
We worked with three scenarios: observed, postponement stops, and postponement continues. For each scenario, we have constructed increment-decrement fertility life-tables and calculated lifetime probabilities (Equation 4) for synthetic cohorts by parity order. In the observed scenario, we applied the observed occurrence-exposure rates ($m_j(a)$), in the postponement stops we're assuming the influence of delaying during some and stop.

$$p_j^T(x, y|\gamma_j^s \delta_j^s) = 1 - exp[-\int_x^y m_j^s(a, T + a - x)da] = 1 - exp[-\int_x^{y - R_j^s(y, T+(y-x))} m_j^s(a, T)da] \tag{4}$$

Results

Following, we are going to show our findings. In the Figure 0.1, we display the average number of children ever born by country and age-group. We derivated it from the reconstructed birth histories. Overall, it is very clear the decline in women's final parity over the years. The findings for Uruguay differ from the others. In the 1980s the final parity of Uruguayans was already close to two and this trend continued until 2010. In countries, such as Colombia, Chile, and Brazil, we may observe a significant decline in the final parities from values equal or over 4 to close to 2 in the last observed year. Even demonstrating high final parities in the 1980s and 1990s, Ecuador and Peru also presented a decrease during the period analyzed.

Figure 0.1: Average Parity by Age Group and Country (1980 - 2010)



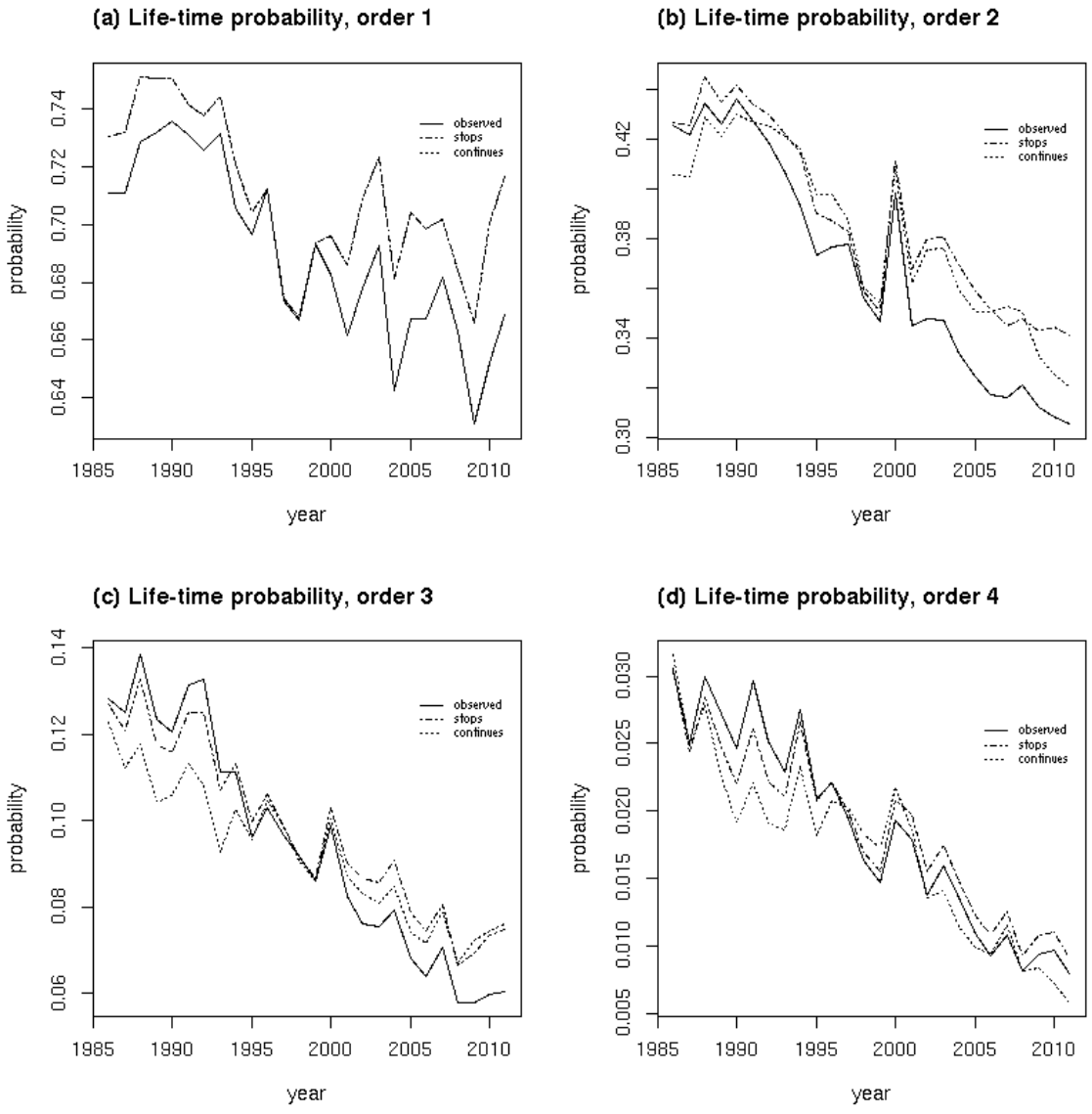
Source: Author's calculations from IPUMS microdata

Further, from (Figure 0.2) to (Figure 0.7) we display the results for the life-time probabilities. The life-time probabilities indicate the probability of a woman at age 15 in the reference year T reach 40 years old with at least a parity j. When the observed curve is lower than the postponement one, it means the tempo effect is acting to deflate fertility rates. It means that women are delaying their birth. In general, all countries analyzed presented a considerable decline in their probabilities for all parities. However, the decline was pronounced in the probabilities to 3rd and 4th birth.

In the case of Uruguay (Figure 0.2), the life-time probabilities fluctuate for parities 1 and 2 but present a declining trend. This might be explained by its advanced stage on the fertility transition, which remained close to 2 children per woman for a long time. In the first births life-time probabilities, any difference was observed between the postponement lines. Before 1995, we can note signs of postponement of the first child, which continued when it closes to 2000. After that, the gap is significant. On the one hand, while 71% of women at 15 in 1985 would have at least one child at 40, in 2011 it would felt to 66%. On the other hand, in the absence of a tempo effect, this result would be 71%.

In the case of 2nd children, besides a spike in 2000, the probability shows a clear tendency of decline. At the beginning of the period, 42% of women would have a 2nd child by 2010 compared to only 30% by 2025. Thus, in the absence of postponement, it would be 34%. The scenario is more intense when we focus on parities 3 and 4. In 1985, they were already low, 11% and 3%, respectively. By 2011, the values reach 6% and 0.5%.

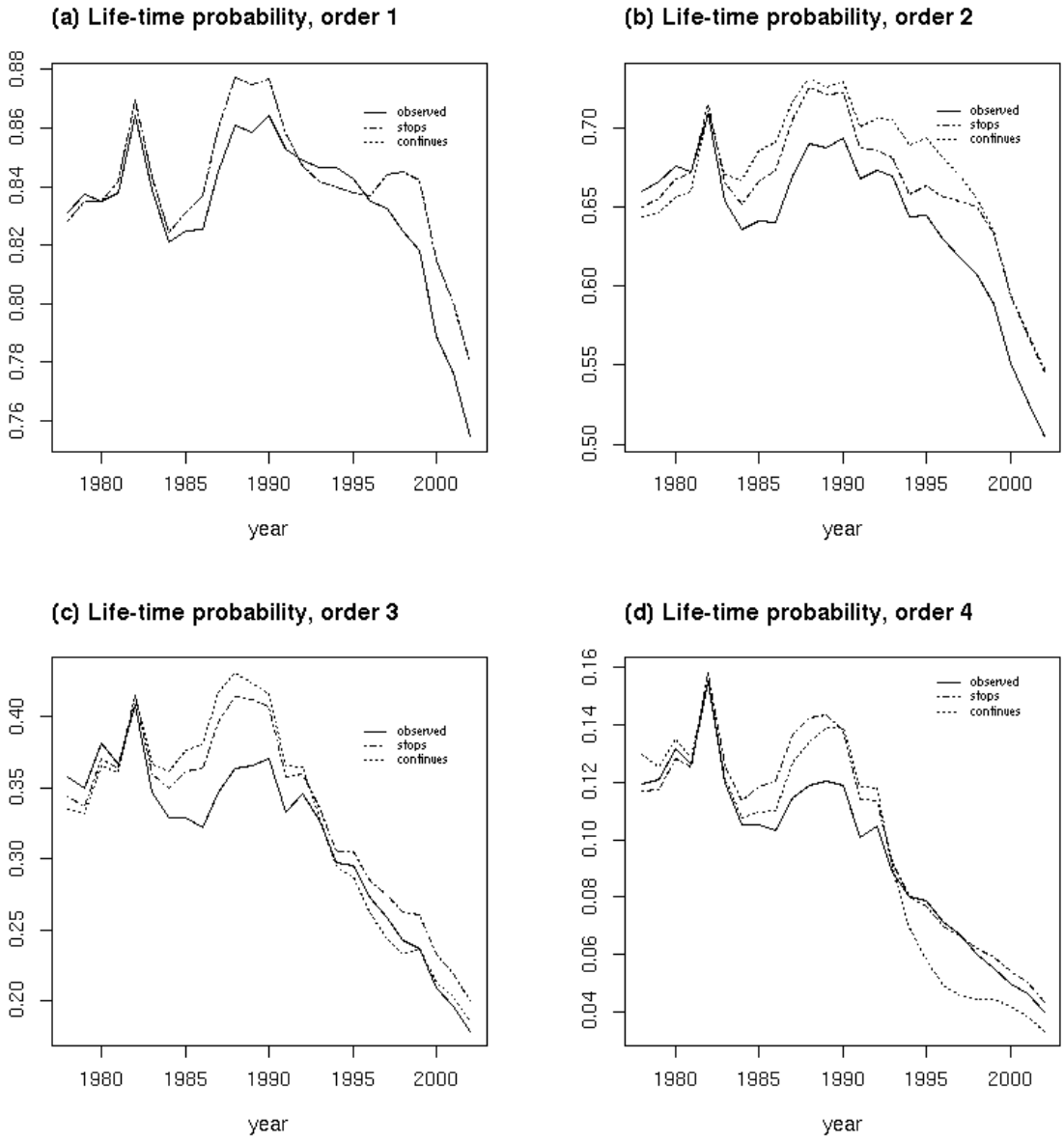
Figure 0.2: Life-time probabilities-Uruguay



Source: Author's calculations from IPUMS microdata

In Chile, the decline in all observed birth orders was intensified among cohorts born after the 1980s, as we observe in Figure 0.3. The period between 1980 and 1990 is marked by fluctuations. The first birth lifetime probabilities, observed and postponement, collapsed after 1995 from 84% to less than 75% (observed) and 78% (postponement). The same pattern is seeing in the second-birth probabilities. Concerning 3rd and 4th births, the proportion of women achieving these parities in 2027 might be even lower, 20%, and 4% in all scenarios, respectively.

Figure 0.3: Life-time probabilities-Chile

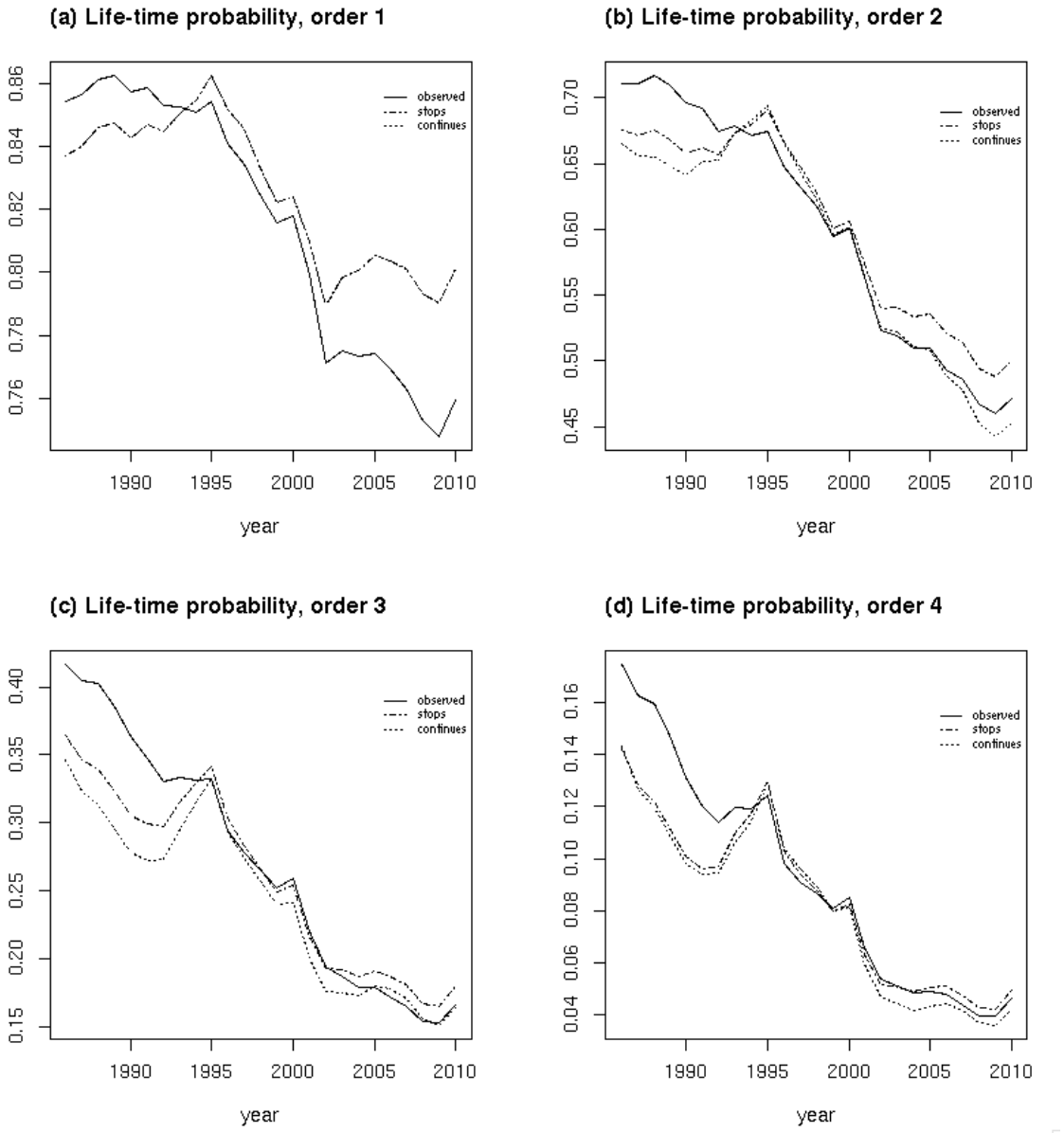


Source: Author's calculations from IPUMS microdata

Brazil's findings (Figure 0.4) display similar patterns to those we found in Chile and Uruguay. The Figure 0.4a shows women that would achieve their 40's between 2010 and 2035. According to the results, there is not evidence of tempo effect before 1993, when the curves of postponement and observed probabilities inverted positions. This evidence insinuates these women, who were 15 in 1993 and 40 by 2018, might be influenced by the tempo effect. The evidence of first birth delay also manifests in the cohorts ahead. Moreover, the tempo effect intensifies in the 2002 reproductive cohort. Concerning the life-time probabilities, while 86% of women finishing their reproductive period in 2010 would have at least one child by 40, only 76% would become mothers by 2035. The

life-time probabilities of second, third, and fourth births also show a significant decline. According to the results, the proportion of women with at least two children would fall from 70% (observed) to 47% between 2010 and 2035. The births of orders three and four suffered considerable changes. In the former, it dropped from 40% to 15% and in the last fell from 16% to 4%. Changes in first birth are consequently impacting the subsequent parities.

Figure 0.4: Life-time probabilities - Brazil

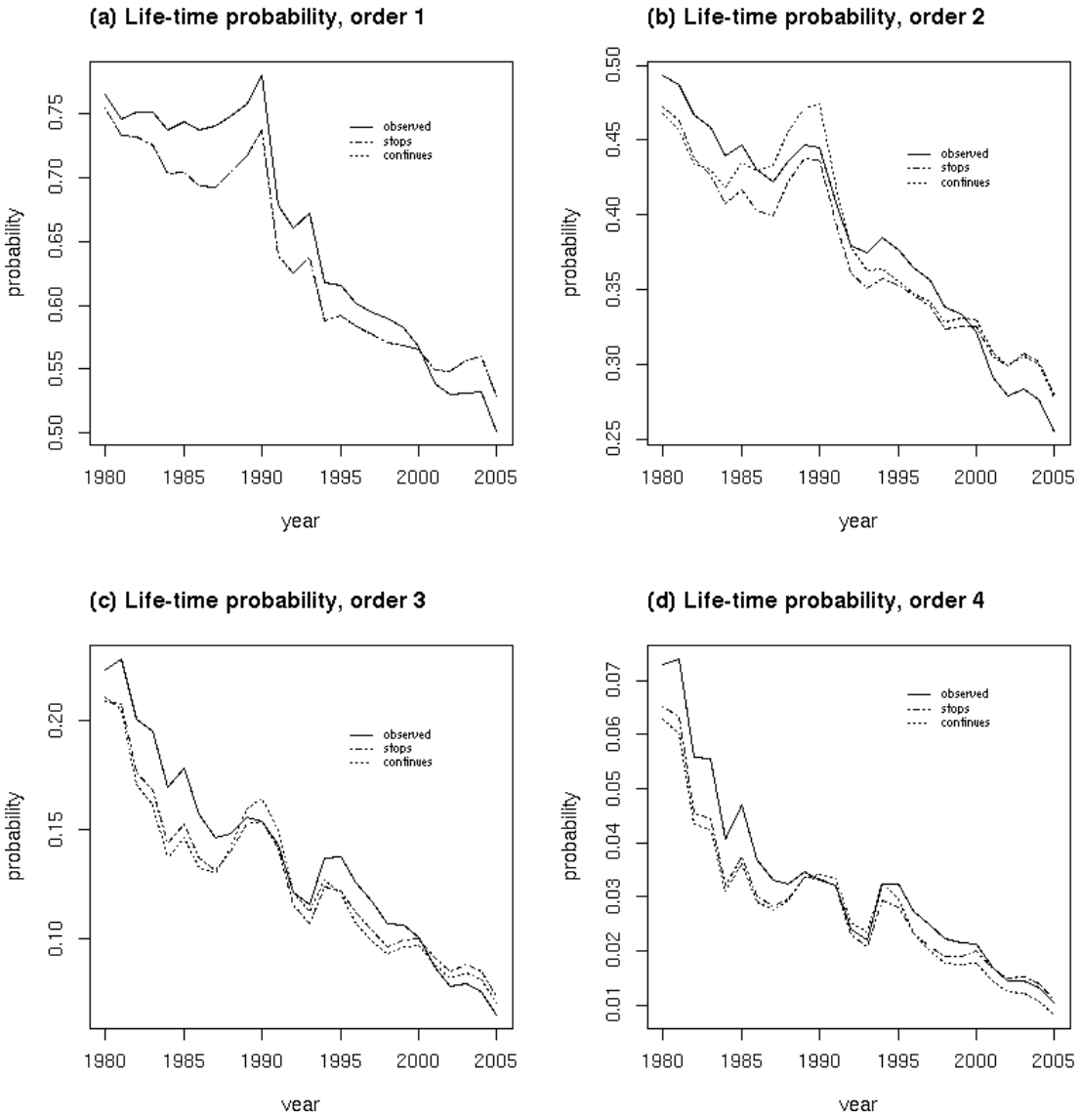


Source: Author's calculations from IPUMS microdata

The results regarding Colombia Figure 0.5 display similar trends to Brazil's. Nevertheless, the pace is more intense. The first births life-probabilities for synthetic cohorts between 1979 and 2005 dropped from 75% to 50%. It means that by 2030 (2005 + 25) half of the women in their 40's

would be childless. Curiously, before 2000 the births would be inflating the TFR. The subsequent parities declined considerably. The proportion of women from reproductive cohorts in 2030 having at least two, three, and four children is 25%, 5%, and 1% respectively. The behavior of synthetic cohorts reflects the rapid decline in fertility over the past years.

Figure 0.5: Life-time probabilities - Colombia

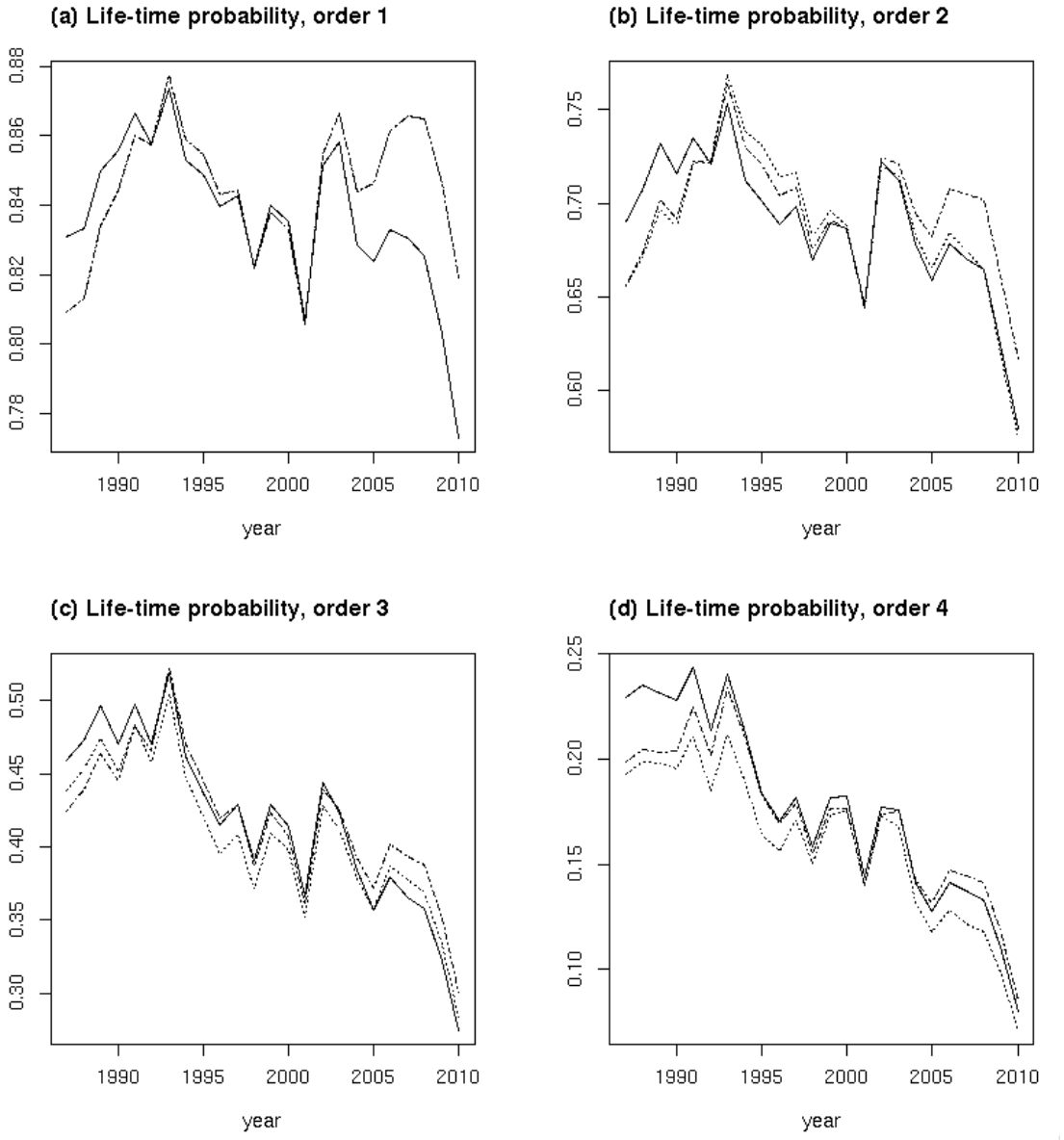


Source: Author's calculations from IPUMS microdata

Compared to the other countries analyzed, the results for Ecuador Figure 0.6 show interesting features. The synthetic cohorts have not displayed trends before 2003 for first and second births life-time probabilities. In the case of first births, we might observe the influence of the tempo effect indicated the observed line's position, which was below the postponement ones. Additionally, compared to countries in an advanced stage of fertility transition, the percentage of women having

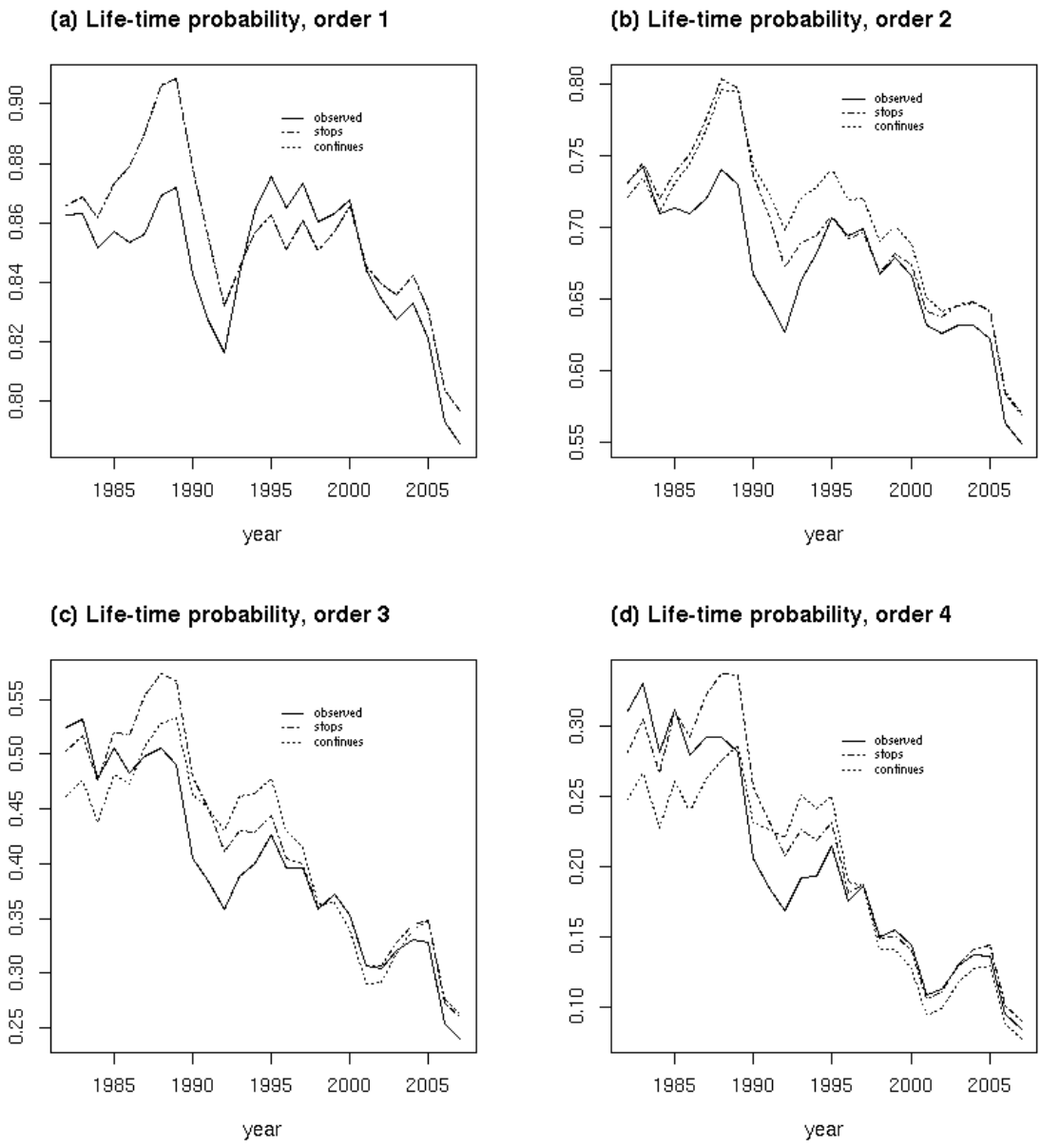
at least three or four children by 40 in the last observed year in 26% and 5%.

Figure 0.6: Life-time probabilities - Ecuador



Source: Author's calculations from IPUMS microdata

Figure 0.7: Life-time probabilities - Peru



Source: Author's calculations from IPUMS microdata

Discussion and Conclusion

This article seeks to answer how women in a given reproductive cohort would behave under specific rates of a given year, which would affect their reproductive interval. Observing the results, several features stand out. First, we have to highlight the reduction of the lifetime probabilities for the third or fourth parities. In countries in a more advanced stage of the fertility transition, such as Uruguay, Chile, Brazil, and Colombia, the percentage of women who could have a third or fourth child is getting smaller. These countries already present fertility rates below the replacement levels

(Batyra 2016; Lima et al. 2018; Miranda-Ribeiro, Garcia, and Bernardes 2019).

The results derived from the synthetic cohorts demonstrate that the pace of decline in life-time probabilities of order 3 and 4 is consistent with the fall in final average parity in the countries. Due to the modest advance of postponement in these countries, it can be inferred that the adoption of methods that limited the number of children was more effective until a given moment. In Ecuador and Peru, the proportion of women with third and fourth children is higher than in the others. However, their results lead us to believe they would follow the same path as the others.

The difference between life-time probabilities for the second and third children is significant. This corroborates with women's preference for two children. The proportion of women pertaining to the synthetic cohort who would have their second child also reduces considerably, especially after the time effect begins to influence.

As the lifetime probabilities for the first child are declining, the subsequent parities are been affected. The postponement is reducing their available time to having more children, reinforcing the fertility aging process (Kohler, Billari, and Ortega 2004).

In a hypothetical scenario, the patterns applied in this study are adopted, the proportion of childlessness women would increase in Latin American countries, as it is happening in many developed regions (Tanturri et al. 2015).

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