Bimodal Age-Specific Fertility Profiles in Latin America: The Case of Chile and Uruguay

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In this paper we follow up with the work of Chandola et al. (1999; 2002) and Sullivan (2005) on bimodal patterns of fertility schedules in Anglo-Saxon populations. Using newly available data for Uruguay and Chile, we have found that such patterns are emerging also in these Latin American countries, especially for first births. The attention of this study is to analyze the heterogeneity within the first birth fertility patterns of those countries. A two-component mixture Hadwiger model is applied in order to study this heterogeneity and relate it to the socio-economic determinants of timing of first birth. The results suggest that primary maximum of teen-age fertility is accompanied by a secondary peak at age around 28. The levels of education along with marital status and economic activity play an important role in the timing of first births in these Latin American countries.

Keywoords: Fertility, Latin America, Bimodal Pattern

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1 Introduction

Like other regions of the world, Latin America has undergone demographic transition, which has been more rapid than in today's most developed regions. Mortality started to decline in the first half of the twentieth century, while birth rates remained at relatively high levels, and even increased in some countries between 1950 and 1960 (Guzmán and Rodriguez 1993). In the early 1960s fertility started dropping rapidly throughout most of the region. Over the last five decades, the total fertility rate in the region has dropped from 5.9 children per woman during 1950–1955 to 2.4 children per woman during 2005–2010.The annual number of births had increased, between 1950–1955 and 1990–1995, from 7.5 million to 11.5 million, and then started decreasing due to the continuing decline in fertility. According to Saad (2009), for the next four decades it is expected the fertility levels to remain below but close to the replacement level of 2.1 children per woman.

According to Guzman et al. (2006) the fertility decline in the region was not uniform, but it can be distinguished in different tempo and levels of transition. They identify and describe four models of demographic transition in the region. Firstly, two of the Southern Cone countries – Argentina and Uruguay – began their transition very early, under the effect of economic and social development and intensive European immigration, following a similar pattern to Europe. In Uruguay, for example, the early onset of fertility transition is dated from the beginning of the 20th century, reaching a total fertility rate of 2.7 in 1950, a level well below the Latin American average (Pellegrino et al. 2008).

A second group classifies countries that are currently in a situation of early or moderate transition (Chackiel 2004). These countries began their fertility transition much later and much more slowly, including the following countries: Guatemala, Honduras, Haiti and Bolivia. The third and largest group comprises of the countries that follow the most typical transition model over the period, with the two largest countries, Mexico and Brazil, along with Peru, Ecuador, Colombia, Venezuela, Panama, Costa Rica, El Salvador, Dominican Republic and Jamaica. Chile, however, is classified in an intermediate position. Its transition process is similar to that of the third group, but started from lower rates (Guzman et al. 2006).

According to Bozon et al. (2009), the timing of female initiation in sexual activity and union formation are very important in the socialization process of gender in the teenage life cycle in Latin America, as the young male are encouraged to sexual initiation as early as possible and the females suffer more due to social control. Authors state clearly the interconnection between first intercourse, union formation and birth of the first child. Social differences in the timing of female sexual debut are related to similar differences in first union. A separation between sexual debut and first union is growing in some Latin American countries. The authors claim the existence of "teenage Latin American paradox": fertility has declined historically in the region, moving towards replacement level in several countries, but without clear postponement of childbearing. Therefore, age at first child is persistently low and stable among cohorts. Furthermore, the authors indicate that the more educated group of women is starting to show some postponement behavior with an increasing rate of childless women.

Esteve et al. (2013) focus on the role of educational expansion in the postponement of union formation. They claim another kind of paradox, this time concerning union formation, which has not historically declined with the expansion of educational attainment in the region. To them the increasing share of cohabitation would help to explain this inconsistency in the explanation of the postponement of union formation in the region. Rios-Neto and Guimaraes (2014) stressed that tertiary education is the driving force behind new low fertility patterns in the region. Continuing educational expansion in tertiary education in the region could lead to a fertility decline more in the direction of the lowest-low fertility levels.

Together with the general decline in the region, the timing and pattern of fertility varies considerable across countries, with adolescent fertility not declining steadily in the same way as overall fertility. Trends in age-specific fertility rates show that reduction in fertility has been greatest among women in older age groups, especially those aged 35 to 49, but very limited among adolescents aged 15 to 19. According to Saad (2009), the rate of adolescent fertility has almost doubled as a share of total fertility over the last half-century, from 8.5 percent in 1950–1955 to 14.3 percent in 2000–2005. In both Chile and Uruguay, the marked fertility decline over the last 15 years is almost exclusively due to the drop in fertility between ages 20 and 29, while adolescent fertility is decreasing at a slow pace (INE Chile 2004; Varela et al. 2008), after even rising during 1990s (ECLAC 2012).

Furthermore, recent empirical data on firth-births rates, in Chile and Uruguay, display a bimodal fertility pattern — very similar to the findings of Chandola et al. (1999; 2002) and Sullivan (2005), who have identified bimodal fertility pattern in many English-speaking countries, like Australia, Canada, New Zealand, UK, Ireland and the United States. In this regard, Nathan et al. (2014) show the emergence of a bimodal pattern of conditional first-birth rates in Uruguay, between 1996 and 2011, while the total fertility rate declined below the replacement level. According to them, this shift in the pattern of first births should be interpreted as a result of a social polarization process in the timing of entry into motherhood, as documented in Varela et al. (2012) and Nathan (2013).

Given this context, in this paper we follow up with the work of Chandola et al. (1999; 2002) and Sullivan (2005) on bimodal patterns of fertility schedules in Anglo-Saxon populations. Using newly available data from vital registration for Uruguay and Chile, we have found that such patterns emerged also in these Latin American countries, especially for first births. The attention of this study is to analyze the heterogeneity within the fertility patterns of those countries. A two-component mixture Hadwiger model is applied in order to study this heterogeneity and, as other studies did, relate it to the socio-economic determinants of fertility timing. The results show that high teen-age fertility is accompanied by secondary fertility peak at age around 28, and the level of education along with marital status and economic activity play an important role in the timing of first births.

2 Previous Research in Determinants of Bimodal Fertility

Bimodality patterns in fertility schedule came into the focus of demographers at the end of the 1990s, when these patterns emerged in some Anglo-Saxon populations. Chandola and colleagues (1999; 2002) studied bimodal patterns of fertility rates in Australia, Canada, New Zealand and USA. They applied mixed Hadwiger model and, in this paper, we partly proceed from their work. They suggested that the heterogeneity is related to differences in timing of births by marital status in many English-speaking countries. They also indicate that ethnic differences play an important role to explain fertility bimodality in USA and in the New Zealand.

The mixed Hadwiger model along with other models was compared in methodological paper by Peristera and Kostaki (2007). They found intense “bulge”, or “hump”, in first birth fertility rates in young ages not only in UK, Ireland and USA, but also in Denmark, Norway, Sweden, Italy and Spain. They link the heterogeneity to a group of fertility determinants such as marital status, religion, educational level and ethnic differences.

In other study, Garenne et al. (2000) used Coale-McNeil and Coale-Trussell models for decomposing age patterns of fertility in rural South Africa in 1992-1997 into premarital and marital fertility. According to them, the bimodal fertility pattern in this country can, in great measure, be explained by differences in marital status. Moreover, Roig Villa and Castro Martin (2007) studied fertility of Spanish and foreign women, in Spain 1998-2002, to find huge differences in timing of fertility between native and immigrant mothers.

Using rates of a first kind, Sullivan (2005) studied bimodality in fertility in USA in 1990-2002. She noticed an apex of bimodal fertility between 1994 and 1996. According to her, education and ethnicity are the main determinants behind this bimodal fertility pattern in the country.

In the next sections, we will first describe the methods and data used to analyze bimodal first births fertility in Chile and Uruguay. Afterwards, we will present the analysis of bimodality applied to unconditional fertility rates of both countries. Finally, we will compare the bimodal fertility pattern of these two Latin-American countries with the USA using conditional fertility rates

3 Data and Methods

For the analysis, we make extensive use of data from the Human Fertility Collection (HFC; http://www.fertilitydata.org) and from the Human Fertility Database (HFD; http://www.humanfertility.org). The HFD and HFC are joint projects of the Max Planck Institute for Demographic Research (MPIDR) in Germany and the Vienna Institute of Demography (VID) in Austria. The both databases are designed to incorporate a variety of international fertility data. While HFD includes high quality data for countries with very good quality of vital statistics, and incorporates data on births, exposures, and fertility rates by age, cohort, and birth order in variety of formats and dimensions, HFC includes data series on age specific fertility rates that are valuable for fertility research but do not necessarily meet all quality standards of the HFD. Currently, HFD includes high quality data on fertility in Chile for period 1992 to 2005 (Castro and Zeman 2014). HFC includes age specific fertility rates for Chile, 1952-2011 (Zeman and Castro 2014a; 2014b) and for Uruguay for 1996-2011 (Cabella et al. 2014).

The Chilean data were computed from two sources. The Ministry of Health (Ministerio de Salud) provided individual birth records for 1990-2011 from which live births by age, birth order and socio-economic characteristics were tabulated. The information on female population by age groups was taken from INE Chile (2009) and from census 2002. Birth data for Uruguay 1996-2011 were computed from the Live-Birth Certificate microdata, provided by the Ministry of Public Health and the National Institute of Statistics of Uruguay. Female population estimates by single age were provided by the National Institute of Statistics of Uruguay (INE Uruguay 2014) and from the census 2006.

This study focuses on first-births rates, because the timing of this order of births is very important for understanding the current and future overall fertility trends (Morgan 1996). First childbirth implicates a transition to motherhood, which remains a major life-course event worthy of study (Sullivan 2005). Yet, Sullivan (2005) also highlights the increasing dispersion of the age at first birth, especially in the USA in the 1990s, which might indicate the emergence of a bimodal pattern. She explores such humped fertility pattern based on analyses of the rates of the first kind (also known as hazard rates or occurrence/exposure rates), which differ from the rates of the second kind in that the denominator includes only those people who are at risk of an event (Kohler and Ortega 2002; Bongaarts and Feeney 2006). In the hazard rates of first birth fertility, the exposures are childless women, the only group who are at risk of a first birth. We call them conditional fertility rates in this study and denote (according to the HFD methodology) m1. However, demographers who have studied fertility have used more frequently birth rates of the second kind, such as age-specific fertility rates, because they are easy to calculate and widely available. We call them unconditional fertility rates in this study and denote ASFR1.

The unconditional rates ASFR1 are reflecting the distribution of first births by age in a synthetic cohort of women, and they are directly interpretable when decomposing the age fertility schedules into two or more sub-groups, because the unconditional rates are a sum of fertility rates of these sub-groups, e.g. ASFR1 of married women plus ASFR1 of non-married women gives overall ASFR1, and the same is true for total fertility rates TFR1. While unconditional fertility rates explain how the first births are distributed across the women reproductive life span, the conditional fertility rates describe the childbearing intensities of women by age.

In this study, we first analyze the humped fertility distribution based on unconditional rates of first birth, for two reasons. First, partly due to data availability and, second, because the Hadwiger decomposition allows a direct interpretation of unconditional rates for two sub-populations (Chandola et al. 1999; 2002). For periods where the female childless population is available (censuses 1992 and 2002 for Chile and censuses 1996 and 2011 for Uruguay), we supplement our study by analysis of conditional fertility rates m1, also in order to give direct comparison with study of Sullivan (2005) on US fertility patterns.

The analysis of bimodal fertility patterns employs mixture Hadwiger function, which is an adaptation of the original Hadwiger function $f(x) = \frac{ab}{c}\left(\frac{c}{x}\right)^{3/2} exp\left\{-b^2\left(\frac{c}{x}+\frac{x}{c}-2\right)\right\}$. The advanced mixture Hadwiger model has been performed by Chandola et al. (1999; 2002), and replicated by Peristera and Kostaki (2007). We use modified form of mixture Hadwiger model using reparametrization of Ortega and Kohler (2000) that allows for direct demographic interpretation of the parameters:

$$f(x) = \frac{F_1}{\sqrt{2\pi\sigma_1^2}}\left(\frac{\mu_1}{x}\right)^{3/2} exp\left\{-\frac{\mu_1^2}{2\sigma_1^2}\left(\frac{\mu_1}{x}+\frac{x}{\mu_1}-2\right)\right\} + \frac{F_2}{\sqrt{2\pi\sigma_2^2}}\left(\frac{\mu_2}{x}\right)^{3/2} exp\left\{-\frac{\mu_2^2}{2\sigma_2^2}\left(\frac{\mu_2}{x}+\frac{x}{\mu_2}-2\right)\right\}$$

Where, *x* is the age of the mother at birth. Parameters *F1* and *F2* represent the total level of fertility of first and second subgroup; thus *F1* related to *F1+F2* represent the relative size of the first component distribution (and is equal to parameter *m* of original Chandola's formula); σ_1^2 and σ_2^2 represent the variance of respective subgroups' fertilities, and μ_1, μ_2 represent the mean age of motherhood of each distribution (in the graphs we use notation *f* for *F*, *s* for σ^2 and *m* for μ).

4 Unconditional fertility rates – Preliminary Results

Figures 1 and 2 provide the decomposition of age specific fertility rates of first birth, fitted to Hadwiger model and the mixture Hadwiger model for year 2010 in Chile and Uruguay. The fertility schedules show clear bimodal pattern that is very well captured by the mixture Hadwiger model, while simple Hadwiger model gives poor fit. This provides us with a strong indication that the fertility schedule has two distinct components, often even visually bimodal, which further leads us to the question whether such bimodality can be explained by decomposition of fertility rates by certain socio-economic characteristics in the real population.

In Figures A1 and A2, in appendix, we show such decomposition of age specific fertility rates of first births by selected (available) socio-economic characteristics: education, marital status and economic activity for Chile 2002 and Uruguay 2006. We must note that all these characteristics are time-varying, which implies to say that they can be endogenous to the process of fertility (especially marital status, when lot of young women gets married when they are pregnant, but they can also drop out of education or economic activity because of pregnancy). All these characteristics were frequently shown to have important role in timing of births, and all these characteristics are interrelated. Given quite regular age profile of the population, unconditional ASFR1 show more-or-less the distribution of births by SES. Comparing Hadwiger models with real fertility rates in both countries, we conclude that the first maximum of fertility before age 20 is strongly correlated with low education, non-marital fertility, and economic inactivity, while second hump at age around 28 is related to highly educated women, married mothers, and women economically active. The only important difference between Chile and Uruguay is that while in Chile the primary education is quite low frequent and the first, young-age component of fertility is related to secondary educated women, in Uruguay the secondary educated are rather similar to tertiary educated women.

Figure 1 Age specific fertility rates of first birth, fitted to Hadwiger model and the mixture Hadwiger model; Chile 2010.

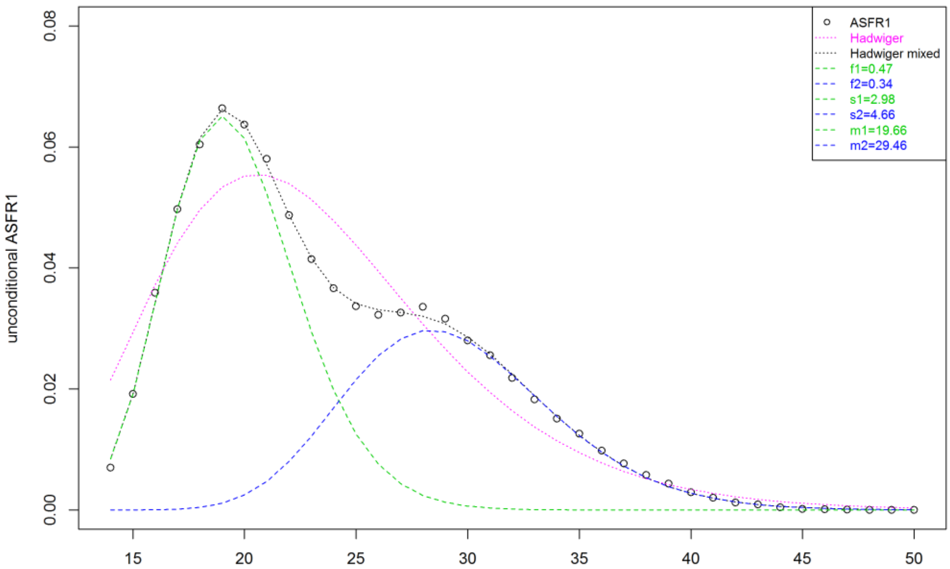
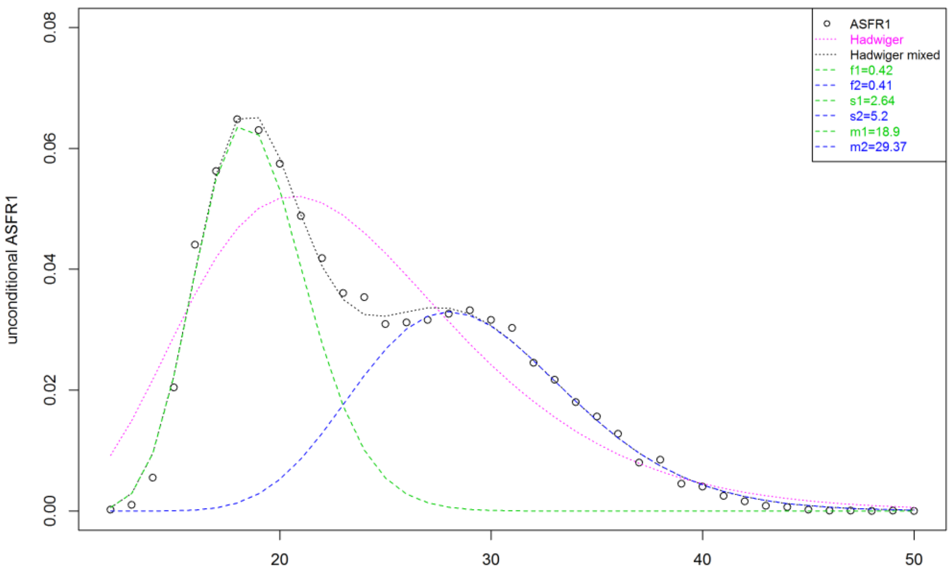


Figure 2 Age specific fertility rates of first birth, fitted to Hadwiger model and the mixture Hadwiger model; Uruguay 2010



The Hadwiger parameters have also direct demographic interpretation and can be compared to real fertility parameters of certain subgroups. Notably, parameters μ_1, μ_2 representing the mean age of motherhood of each distribution display very differing development. While the mean age of younger distribution fluctuates around age 19 in both countries, the older one increases from 24 or 26 to almost 30 years of age during the period under investigation. This resembles very closely to the mean age of non-married vs. married mothers, of economically inactive vs. active (Figure 3 for Chile), or low vs. high educated (Figure 4 for Uruguay).

Figure 3: Mean age at first birth by economic activity of mother, compared to mixed Hadwiger model parameters μ_1, μ_2 *(denoted m1, m2)*, Chile 1990-2011

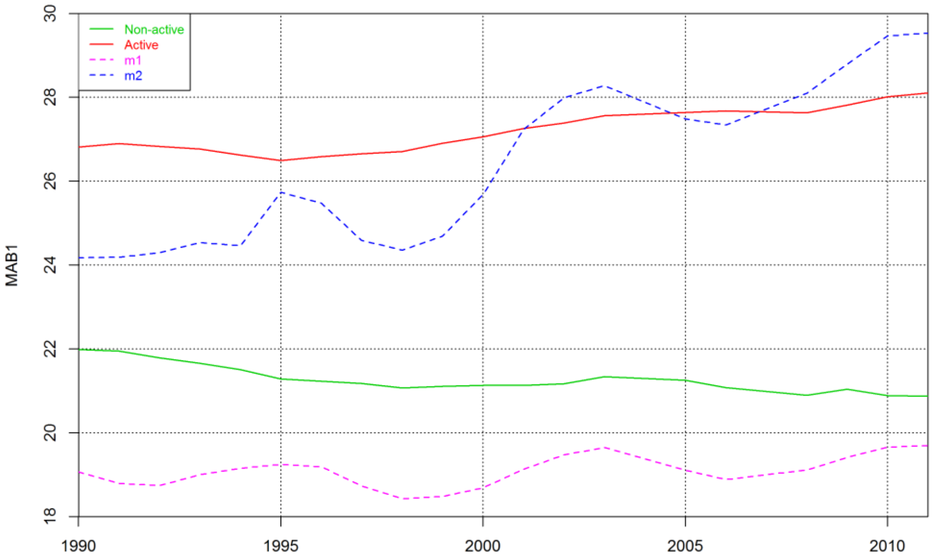
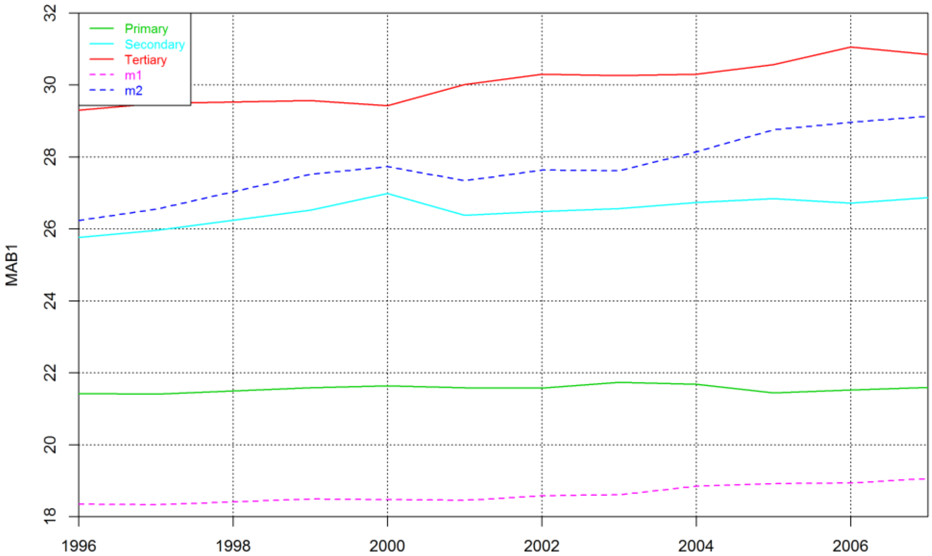


Figure 4: Mean age at first birth by highest attained education of mother, compared to mixed Hadwiger model parameters μ_1, μ_2 *(denoted m1, m2)*, Uruguay 1996-2007

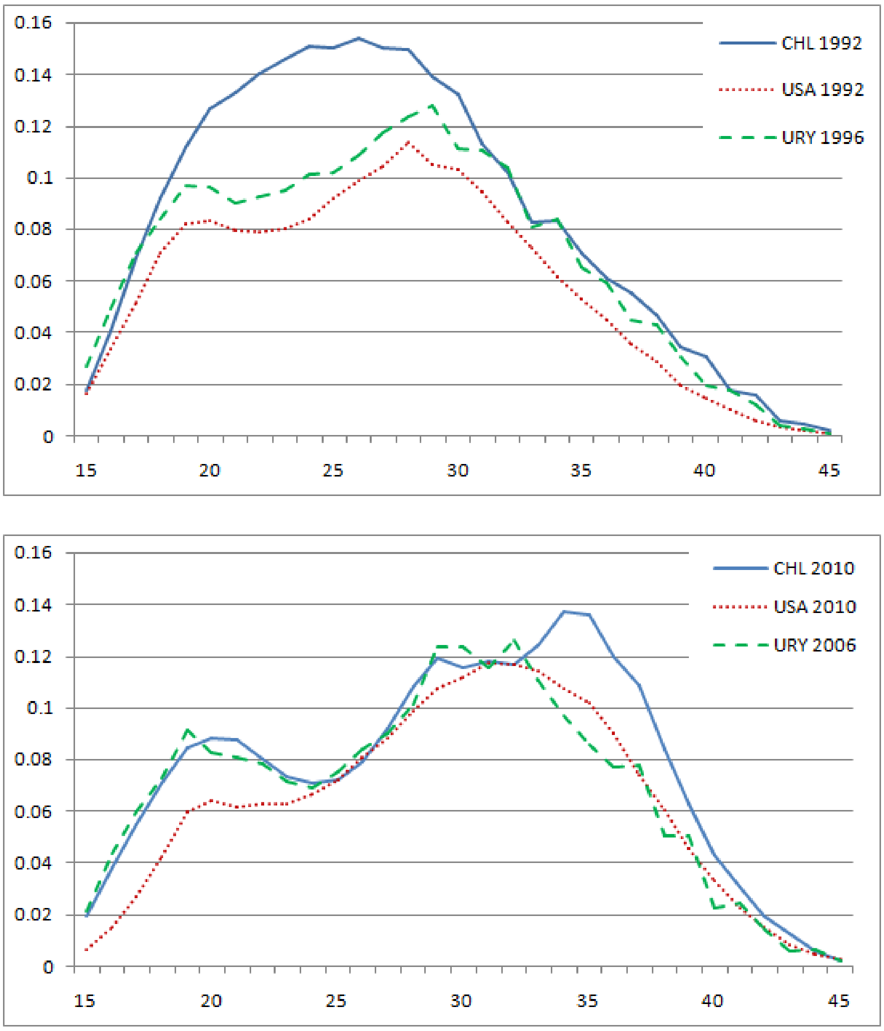


5 Conditional fertility rates in Chile, Uruguay and USA – Preliminary Results

Conditional and unconditional fertility rates display very different age schedules. While unconditional rates have distinct maximum before age 20, with secondary peak around age 28, conditional rates have inverse shape, with secondary maximum at young ages and primary maximum around age 30. Figure 5a-b shows the comparison of conditional fertility rates m1 in Chile, Uruguay and in USA in periods of the 1990s and 2000s. According to Sullivan (2005), period of the 1990s was the one with most distinct bimodal age patterns of conditional first-birth rates. Evidently, the pattern with clear existence of enhanced early-age fertility is persistent also until the most recent periods (see also Peristera and Kostaki 2007).

The situation in Chile was changing quickly: while in 1992 there is a high level of fertility through the long age-span of about 20-30 years, since 2002 the age schedule is shifting towards the pattern of USA, with high intensity at late-teen ages, and second peak around age 30. In 2010, we even identify third peak at age 35[6].

Figure 5a-b: Conditional fertility rates of first birth, selected years, Chile, Uruguay and USA



[6] The conditional rates are dependent on the number of childless women, so not only number of births but also diminishing number of childless women has to be taken into account. At age 35, the number and the proportion of childless women is relatively low (less than 10% according to period fertility tables), so the third peak at that age is rather statistical artifact than sign of change in real behavior of women.

From the census data, we have computed also simple but very interesting indicator of proportion of childless women. In Chile the ultimate childlessness at age 50 of married women is just 5% while it is more than 20% for non-married. There is clear gradient by education (10/13/20% for low/mid/high educated in 1992), nevertheless weakening (9/11/15% in 2002). Among economically active the childlessness at age 50 in 2002 was 15%, while among inactive it was only 7%.

6 Conclusions and Discussion

First births fertility schedule show bimodal pattern or nearly bimodal pattern, with strong evidence that the distribution has two distinct components, since 1996 in Uruguay and since 2002 in Chile. This pattern is presented in both conditional and unconditional fertility rates.

Conditional and unconditional fertility rates display very different age schedules. While unconditional rates ASFR1 have distinct maximum before age 20, with secondary peak around age 28, conditional rates m1 have inverse shape, with secondary maximum at young ages and primary maximum around age 30.

Unconditional fertility rates were decomposed statistically into mixture Hadwiger model with two components. These components have very distinct parameters. The first component has very low mean age of about 19 years, while the second one has increasing mean age from 24 to 30 during studied period (26 to 30 in Uruguay). The total fertility of both components is of comparable level, fluctuating around 0.4. Variance of second component is about twice as high as for the first component. While the first component strongly resembles the fertility rates of women with low and medium education, non-married, and economically inactive, second component is similar to fertility rates of highly educated women, married mothers, and women economically active. Education, marital status and economic activity all have important role in timing of births, but these characteristics are interrelated.

As some scholars have pointed out, the fertility transition process in the region has multiple reasons and factors, such as the degree of urbanization, years of education of women and differences according to socio-occupational strata (Petito, 2005; Vignoli, 2013).

Petito (2005) highlights, in particular, the clear association between fertility and education in Uruguay, where the most educated women have much lower fertility than uneducated women do. Furthermore, the education levels explain in great extent teenage pregnancy and early motherhood. Thus, in the recent period, a great percentage of children are born to teenage and young mothers without education and/or incomplete primary education. According to Petito (2005), 71% of teen mothers in the country have completed only primary education and barely 7% have reached full secondary. The illiteracy rates are around 4% for the entire country, however, the levels of school dropout has significantly increased in recent years. On the other hand, young adult mothers (24-29 years old) appear to have achieved much higher education levels (Petito, 2005). Thus, these education differences might reflect in the bimodal fertility curve, as our analysis has shown.

However, not only the education gradient explains the recent heterogeneity in the timing of having the first child. According to Petito (2005), most teenage mothers (79%) are not integrated into economic activity, because a significant portion of them is not old enough to enter in the labor market; it is likely that with the advent of motherhood the job opportunities for these groups are reduced. Nevertheless, young adult mothers present a more favorable situation, with great part of them included in some economic activity.

Distinctions in fertility strata are also to notice across marital statuses. In Uruguay, teenage pregnancy is generally associated with a single mother, who do not necessarily not have a partner. The illegitimate births are associated, to a greater extent, with very young mothers, and the number of illegitimate births decreases with increasing age of the mother (Petito, 2005). However, the so-called "illegitimacy" is a concept that refers to the legality of marriage (civil marriage), and not necessarily means that child grows without the support and presence of both parents.

In Chile, the recent fertility development is comparable to its neighbor country. Specifically we see increase in the postponement of motherhood, specifically observed in the age at first birth. Although 20–24 remains the dominant age group in which women have a first child, there has been an increasing number of first-time mothers after this age.

This change is also observed according to many socio-economic characteristics. While in 1996 the proportion of unmarried women among first-time mothers was 55%. In 2004, this proportion increased to 73%. This happened in great deal due to the effectiveness of a law that no longer discriminates illegitimate births (INE Chile 2007). The educational composition has also changed toward an increase proportion of mothers with more years of education completed.

Examining employment status, in 1996, nearly 50% of women between 25 and 29 years of age worked during the birth of their first child. For women between age group of 30 and 34, the proportion was nearly 60%. In 2004, only 38% of first mothers between 25 and 29 years are active at work, while the number of mothers between 30 and 34 years of age remain close to 60%. We have also noticed an increase number of women who have been inactive between 20 and 24 years.

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References

Bongaarts, J and Feeney, G. 2006. The Quantum and Tempo of Life-Cycle Events. Vienna Yearbook of Population Research 2006, pp. 115-151.

Bozon, Michel, Cecilia Gayet, and Jaime Barrientos. 2009. "A Life Course Approach to Patterns and Trends in Modern Latin American Sexual Behavior." *JAIDS Journal of Acquired Immune Deficiency Syndromes* 51: S4–S12.

Cabella, W., M. Nathan and I. Pardo 2014. Age-specific fertility rates by birth order calculated from Live-Birth Certificate, Perinatal Information System and female population exposures, 1996-2011. Human Fertility Collection documentation for Uruguay. Available at www.fertilitydata.org

Castro, R., and K. Zeman 2014. Human Fertility Database documentation: Chile. Available at www.humanfertility.org

Chackiel, J. 2004. La dinámica demográfica en América Latina, United Nations, Santiago de Chile, ECLAC/CEPAL, Serie Población y Desarrollo no. 52, 104 p.

Chandola, T., D.A. Coleman and R.W. Hiorns 1999. Recent European fertility patterns: Fitting curves to 'distorted'distributions. Population Studies 53(3): 317-329

Chandola, T., D.A. Coleman and R.W. Hiorns 2002. Distinctive features of age-specific fertility profiles in the English-speaking world: Common patterns in Australia, Canada, New Zealand and the United States, 1970-98. Population Studies 56(2): 181-200

Garenne, M., S. Tollman and K. Kahn 2000. Premarital fertility in rural South Africa: a challenge to existing population policy. Studies in Family Planning 31(1): 47-54.

ECLAC 2012. Social Panorama of Latin America 2011. Santiago de Chile: Economic Commission for Latin America and the Caribbean.

Esteve, Albert, Luis Ángel López-Ruiz, and Jeroen Spijker. 2013. "Disentangling How Educational Expansion Did Not Increase Women's Age at Union Formation in Latin America from 1970 to 2000." *Demographic Research* 28 (January 9): 63–76. doi:10.4054/DemRes.2013.28.3.

Guzmán, J. M., Rodríguez, V. J., 1993, "La fecundidad pre-transicional en América Latina: um capítulo olvidado", United Nations, CELADE, Notas de Población, 21(57), pp. 217-246.

Guzmán, J. M. et al. 2006. The Demography of Latin America and the Caribbean since 1950. Population-E, 61(5-6), 519-576.

Human Fertility Collection. Max Planck Institute for Demographic Research (Germany) and Vienna Institute of Demography (Austria). Available at www.fertilitydata.org (data downloaded on 5.9.2014)

Human Fertility Database. Max Planck Institute for Demographic Research (Germany) and Vienna Institute of Demography (Austria). Available at www.humanfertility.org (data downloaded on 5.9.2014)

INE Chile 2004. Anuario de Estadísticas Vitales 2003, Santiago de Chile, INE.

INE Chile 2007. Sumario Tendencias y variables influyentes. In: http://www.ine.cl/filenews/files/2007/mayo/pdf/maternidad.pdf. Accessed: 25/03/2015.

INE Chile 2009. Chile: Proyecciones y Estimaciones de Población. Total País 1950-2050. Instituto Nacional de Estadísticas.

INE Uruguay 2014. Estimaciones y proyecciones de la población de Uruguay, revisión 2013. Montevideo: INE.

Kohler, H.P., and J.A.Ortega 2002. Tempo-adjusted period parity progression measures, fertility postponement and completed cohort fertility. Demographic Research 6(6): 91-144.

Morgan, S.P. 1996. "Characteristic Features of Modern American Fertility." Pp. 19-63 in Fertility in the United States: New Patterns, New Theories, edited by J.B. Casterline, R.D. Lee, and K.A. Foote. New York: Population Council.

Nathan, M. 2013. Inicio de la fecundidad en mujeres de Montevideo y área metropolitana: ¿postergación? ¿polarización? *RELAP* 7(12): 33-58.

Nathan, M., I. Pardo and W. Cabella 2014. El descenso de la fecundidad en Uruguay según el orden de nacimiento (1996-2011). Presented in the VI Congreso de la Asociación Latinoamericana de Población, Lima-Perú, August 12-15 2014.

OEI 1993. “Informe OEI-Ministerio 1993 - Estructura del sistema educacional”. Organización de Estados Iberoamericanos. Accessed on 25/03/2015 in: http://www.oei.es/quipu/chile/CHIL04.PDF

Ortega, J.A.O., and H.P. Kohler 2000. A comment on “Recent European fertility patterns: Fitting curves to distorted distributions” by T. Chandola, D.A. Coleman and R.W. Hiorns. Population Studies 54(3): 347-349.

Pellegrino, A., W. Cabella, M. Paredes, R. Pollero, and C. Varela 2008. “De una transición a otra: la dinámica demográfica del Uruguay en el siglo XX”. In Nahum, B. (editor), *El Uruguay del Siglo XX. La sociedad*. Montevideo: Ediciones Banda Oriental.

Petito, C.V. 2005. La Fecundidad Adolescente: una expresión de cambio del comportamiento reproductivo en el Uruguay. Revista Salud Problema - Nueva Epoca/Ao 4/Número 6.

Peristera, P., and A. Kostaki 2007. Modeling fertility in modern populations. Demographic Research, 16(6): 141-194.

Rios-Neto, Eduardo L.G. and Guimarães, Raquel Rangel de Meireles. The Educational Gradient of Low Fertility in Latin America. In: Annual Meeting of Population Association of America 2014.

Roig Vila, M. and T. Castro-Martin 2008. Childbearing patterns of foreign women in a new immigration country. Population (English edition) 62(3): 351-379.

Saad, P. 2009. Demographic Trends in Latin America and the Caribbean Workshop on Demographic Change and Social Policy organized by the World Bank and held at its Washington, D.C. headquarters, July 14–15, 2009.

Sullivan, R. 2005. The age pattern of first-birth rates among US women: The bimodal 1990s. Demography 42(2): 259-273

Varela, C., A. Fostik and M. Fernandez 2012. Maternidad en la juventud y desigualdad social. Cuadernos del UNFPA, Año 6, Nº 6. Montevideo: UNFPA.

Varela, C., R. Pollero and A. Fostik 2008. “La fecundidad: evolución y diferenciales en el comportamiento reproductivo”. In Varela, C. (coord.), *Demografía de una sociedad en transición: la población uruguaya a inicios del siglo XX*. Programa de Población Facultad de Ciencias Sociales. Montevideo: Trilce.

Vignoli, J.R. 2003 La fecundidad alta en América Latina y el Caribe: un riesgo en transición. In CEPAL. Serie seminarios y conferencias 36 La fecundidade en América Latina: ¿Transición o revolución? Santiago de Chile, 9 al 11 de junio de 2003.

Zeman, K., and R. Castro 2014a. Age-specific fertility rates calculated from official birth counts and population exposures, 1952-1989. Human Fertility Collection documentation. Available at www.fertilitydata.org

Zeman, K., and R. Castro 2014b. Age-specific fertility rates calculated from official birth counts and population exposures, 1990-2011. Human Fertility Collection documentation. Available at www.fertilitydata.org

APPENDIX Figure A1: Age specific fertility rates of first birth, Chile 2002, by various socio-economic characteristics

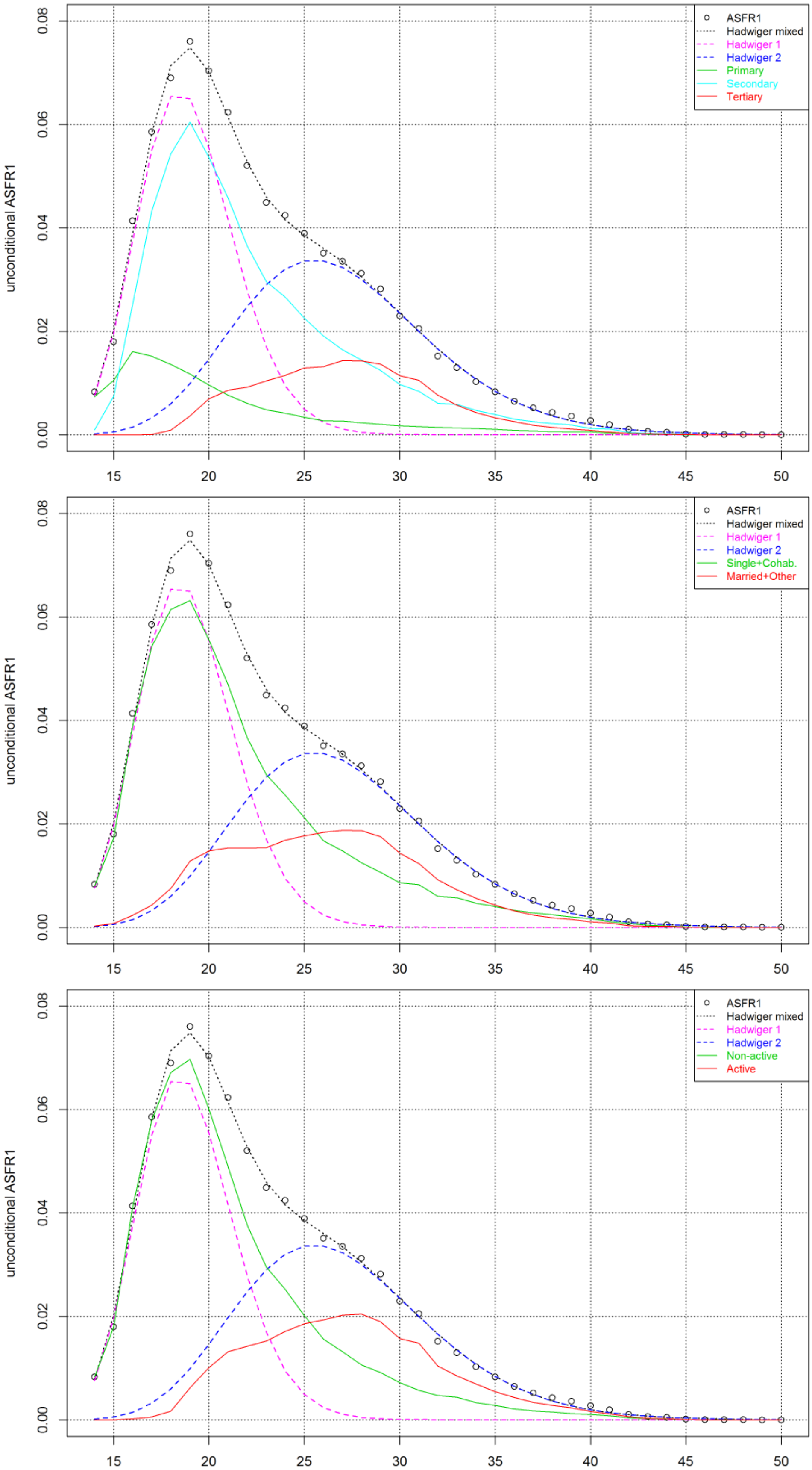

Figure A2: Age specific fertility rates of first birth, Uruguay 2006, by various socio-economic characteristics