# Educational Pairings and Fertility Decline in Brazil: An Analysis Through Cohort Fertility


## Abstract

### BACKGROUND

The fertility transition in Brazil was the result of multiple socioeconomic transformations that initiated from 1930s on-wards. The education expansion plays an important role in this process by promoting changes in social norms and in assortative matching profiles.

### OBJECTIVE

This paper estimates effects of male partners' education on reproductive behavior of couples for Brazil and its regions during the process of fertility transition, taking into account the effects of changes in educational pairings composition.

### METHODS

We compute cohort fertility rates (CFRs) for groups of educational pairings, considering the female cohorts born between the years 1925-1969. The CFRs decline were decomposed between compositional and rate effects using Das Gupta (1993) decomposition methods.

**RESULTS**

In the country, the couple's CFR fell from 6.30 to 2.94 between the analyzed cohorts. Educational pairing composition accounted for approximately 30% of these changes in cohort fertility. Increases in male schooling, especially the jump from incomplete to complete primary education, resulted in significant CFRs reductions, even controlling for female schooling levels.

**CONCLUSIONS**

Results suggest that males' education does affect family size, especially considering older cohorts couples. Additionally, we argue that to a certain extent, a slower male educational expansion might have restrained the pace of fertility transition in some regions of the country.

**CONTRIBUTION**

The cohort analysis and male schooling influences on family size represent good tools to understand Brazilian fertility transition, and it also provides new perspectives of analyses for other Latin American countries that have experienced a similar reproductive decline process.

## 1. Introduction

Brazil observed a significant drop on its total fertility levels from 1960s on (Merrick and Berquó 1983) and since 2010-2015 exhibits below replacement fertility levels (Berquó and Cavenaghi 2014; Castanheira and Kohler 2015; Lima et al. 2018; Rios-Neto, Miranda-Ribeiro, and Miranda-Ribeiro 2018). One main characteristic of this country fertility transition was the heterogeneous process that it took within country regions and across socioeconomic strata, both in terms of transition, starting, timing and pace (Potter et al. 2010).

The pioneers of fertility reduction were social groups with higher socioeconomic status, especially those living in urban and industrialized areas of South and Southeast of the country; they started first practice birth control, even before the beginning of the generalized decline of fertility in the 1960s (Gonçalves et al. 2019; Guzmán and Rodríguez 1993; Merrick and Berquó 1983). To the contrary of other developed regions of the globe, this contraceptive behaviour rapidly spread fast towards the lower status socioeconomic groups from Northern and Northeastern parts of Brazil (Berquó and Cavenaghi 2014; Carvalho and Wong 1992; Perpétuo and Wajnman 1998). For example, in these last regions, social groups with lower education and income began to control fertility by the 1980s, but at a much accelerated pace than other regions, where the fertility decline took place twenty years earlier (Potter et al. 2010; Potter, Schmertmann, and Cavenaghi 2002).

Several factors explain the converging fertility regimes of social groups and thus the fertility transition in Brazil. Industrialization and urbanization, changes in labor market and productive structures, reduction of infant mortality rates, higher access to formal schooling followed by a higher rates of female participation in the labor market, changes in gender relations, expansion of consumer society and communication systems among other factors related to socioeconomic and technological development (Alves 1994; Castanheira and Kohler 2017; Faria 1989; Lam, Sedlacek, and Duryea 1992; Martine 1996; Merrick and Berquó 1983; Oliveira 1989; Paiva 1987; Potter, Schmertmann, and Cavenaghi 2002; Rios-Neto, Miranda-Ribeiro, and Miranda-Ribeiro 2018). Notwithstanding, the difference in paces and periods that each region experienced the fertility transition can be attributed to an uneven spread of these factors through the country, resulting in non-negligible demographic inequalities (Carvalho and Brito 2005; Patarra and Oliveira 1988; Wong and Carvalho 2006; Wood and Carvalho 1988).

Despite the importance of all these variables, we may argue that the expansion of population’s access to education was one of the main drivers of the fertility transition in Brazil (Carvalho and Wong 1992; Lam, Sedlacek, and Duryea 1992; Merrick and Berquó 1983), especially in more recent periods. Education exerts multiple direct and indirect influences on demographic processes (Lutz 2010). For instances, family formation and reproductive behavior are affected by the levels of individual's education, because it provides the basis for human capital formation, which affects in turn the people's life course decisions, by favoring more women participation in the labor market and postponing their the entry into motherhood as consequence (Neels et al. 2017); education may also impulsing changes in the composition of conjugal markets and assortative mating profiles (Esteve and McCaa 2007; Mare 1991; Ribeiro and Silva 2009) and, at last, it helps to shape individual's social and gender norms that foster new ideals of family size (Adserà 2018; Esping-Andersen 2009; Jejeebhoy 1995; McDonald 2000).

In fertility studies, we may cite cohort fertility analysis as well as male fertility intention as tools that are being recently used for the assessment of fertility trends, specially in the context of postponement of childbearing (Neels et al. 2017; Rosero-Bixby, Castro-Martin, and Martin-Garcia 2009; Sobotka 2004), rising female schooling (Esping-Andersen 2009; Neels et al. 2017; Van Bavel, Schwartz, and Esteve 2018) and its consequent effects on changing gender norms, family commitment and reproductive behavior (Adserà 2018; Esping-Andersen 2009; Goldscheider, Bernhardt, and Lappegård 2015;

McDonald 2000). Neither of these approaches have been broadly explored in Brazil, however.

Cohort analysis in Brazil are usually estimated using census or household data, as an alternative to the scarcity of reliable longitudinal surveys to track down life course demographic processes. These data sources provide information that permits the reconstruction of reproductive trends of cohorts in association with the urbanization, industrialization and schooling expansion of the country. By linking cohort analysis of women's reproductive data with the information on their spouse's education, as a way to see the male influences on conjugal reproductive levels, during the course of the country's fertility transition.

Using different Brazilian censuses, we evaluate the cohort fertility of Brazilian educational pairings, taking into account the period of the country's fertility transition. We estimate the cohort fertility of women within specific educational pairings in order to account for male's educational influence on a couple's reproductive outcome. Our analysis also reports regional cohort fertility trends as a way to see how the country's historical regional inequalities could affect fertility levels in each area.

The present work promotes important discussions and brings major contributions to Brazilian demographic analysis. First of all, there are few works that evaluate cohort fertility patterns trends throughout the process of educational expansion. Additionally, this work contemplates the partners that influenced the couple’s reproductive levels (Nitsche et al. 2018; Thomson 1997; Van Bavel 2017). This analysis shed light on hidden processes of fertility transition that act within changes in gender norms and family structure, by assessing reproductive achievements and conjugal educational profiles of several generations, which in turn has experienced different life course processes and thus display diverse family formation.

## 2. Background

### 2.1 Fertility decline and school expansion in Brazil

The Fertility Transition process in Brazil is well documented by many studies. One remarkable characteristic of this process was the contrasting fertility levels among distinguished socioeconomic groups, as for example highly educated social groups already adopted a new reproductive behavior, well previous the beginning of the generalized decline of Brazilian fertility (Merrick and Berquó 1983), and a second noteworthy characteristic is that, compared to more developed regions, in a short period of time the fertility rates of the country from different social strata converged into replacement fertility (Berquó and Cavenaghi 2014), and more recently the TFR is below population replacement levels (Castanheira and Kohler 2015). One particular element that contributed for this rapid transition and fertility convergence processes was the diffusion of contraceptive methods, in particular of female sterilization and the dissemination of contraceptive pill (Martine 1996; Merrick and Berquó 1983; Perpétuo and Wajnman 1998; Perpétuo and Wong 2009). Additionally, the uneven, or in some cases inexistent, access to family planning brought negative implications to the most vulnerable social groups (Carvalho and Brito 2005).

In the country, the low socioeconomic strata generally made use of more harmful and unreliable contraceptive methods (the only methods usually available for them). They mainly used sterilization and clandestine abortion as way to avoid furthers pregnancies, whereas wealthier families consumed other safer contraceptive methods, and they applied female sterilization only when their family size goals was achieved (Faria 1997; Martine 1996; Perpétuo and Wajnman 1998; Perpétuo and Wong 2009). Nowadays, despite similar fertility levels, social groups also present different fertility timing, with lower educated women entering more frequently into motherhood at younger ages than their higher educated peers (Lima et al. 2018), and fertility postponement being more common among this last group of women (Lima et al. 2018; Rios-Neto, Miranda-Ribeiro, and Miranda-Ribeiro 2018).

In common, these studies show how education has become one and, if not, the most important key element to determine fertility outcomes in Brazil. According to Ariès (1978), during the Seventeenth- and Eighteenth-Centuries, the educational systems were set up as important pillars of childhood formation and also seen as a social duty. Since then, schools have gained relevance in shaping individual’s transition into adulthood.

Schooling acts as a strong determinant of reproductive behavior of women through several mechanisms (Jejeebhoy 1995). In particular, formal education affects women’s exposure to childbearing by influencing their labor market participation and conjugal decisions (Castro-Martin and Juarez 1995; Neels et al. 2017). Additionally, education also helps to provide the accomplishment of reproductive intentions, by giving access to information on modern contraceptive methods and through support to scientific knowledge (Cleland and Wilson 1987; Jejeebhoy 1995).

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The massification of educational systems also delivers substantial indirect effects over the population fertility levels. We can mention the increasing social costs of childbearing, promoted by schools and formal education through the cultural changes and the propagation of Western middle class values in the educational institutions (Ariès 1978; Caldwell 1980, 2006; Folbre 1983). One can also argue that higher schooled women have higher probabilities of formal labor market participation, which incurs lower opportunity costs of childbearing than their lower educated counterparts (Adserà 2018; Becker 1993; Goldin and Katz 2002). In addition, the population's formal schooling is a key element in the comprehension of fertility timing (Bongaarts 2003; Chackiel and Schkolnik 2003) and its constraints (Adserà 2018). In most social settings, social elites are the forerunners of reproductive control, due to their higher schooling levels achieved and increased access to modern contraceptive methods (Cleland and Wilson 1987). In addition, some argue that the diffusion of new reproductive behavior from high social groups to lower socioeconomic strata in the society sparks the generalization of the fertility decline (Bongaarts 2003; Cleland and Wilson 1987).

In the context of Brazil, by the time of fertility transition started, its educational system expansion was already ongoing, fomented by a drift shift in economic and production model adopted by the country (Romanelli 1986). By the 1930s, Brazil shifted from a rural society — with an economic model based on the export of agricultural goods — to an urban population with an increasing import substitution industry (Merrick and Graham 1981; Paiva 1987). The Brazilian formal schooling expansion occurred, however, at a slower pace than other countries in South America (Komatsu et al. 2017). Prior to 1930, the pressure for the expansion of educational systems were restricted to minor political groups as a result of the country's rural economy characteristics, described by its cities' geographic disconnection and by an obsolete agricultural productive system (Merrick and Graham 1981; Romanelli 1986; Wood and Carvalho 1988). As a result, the country only reached the universalization of primary education by 1990 decade (Castro 1998).

The rupture between dominant political classes promoted a gradual transformation in the country's economy (Merrick and Graham 1981). In time, Brazil's productive model shifted from an economy based on exports of agricultural goods to an economic model partially based on urban centers and import substitution industries (Merrick and Graham 1981; Romanelli 1986). The capitalist industrial economic model requires a massive educational system to provide productive and consumption capacity for its success (Romanelli 1986). In this sense, this change in production model of the country resulted in a redesign of the country's educational policies.

Along the history, this process of schooling expansion did not follow a linear development through education levels. For example, primary education has received lower investments for its expansion than secondary or tertiary education (Kang 2006; Komatsu et al. 2017; Romanelli 1986). This was partly explained by the adopted education administration structure between government entities. The administration of primary educational systems was under the country's states and municipal accountability, whereas the financial resources were centralized in the federal government (Kang 2011), and this last was also responsible for the tertiary education regulation. Therefore, urbanized industrial municipalities (in the South and Southeast) had more resources to invest in primary education than underfunded areas (from North and Northeast), and that reflects later in the structural inequalities that are still exposed over the country (Barros and Mendonça 1995; Komatsu et al. 2017; Merrick and Graham 1981; Wood and Carvalho 1988).

Consequently, the main transformations in the educational policy in the period from 1930 to 1960 were targeted to prepare the population for an urban-industrial economic model. This was fostered by the foundation of Ministry of Education and Health in 1931, followed by the creation of the National Institute of Pedagogy (which now is the

National Institute for Educational Studies and Research “Anísio Teixeira”), the National Institute of Geography and Statistics (responsible for country’s statistics and national censuses), and national services of industrial and commercial education (Marcílio 2014). In 1961, the first Law of Directives and Bases of National Education, reviewed in 1971, set up the obligation of basic education to the whole population, and established the bases of the current educational system of the country, composed by primary and secondary compulsory schooling (Marcílio 2014). From 1970 to 2000, Brazil experienced relevant increases in enrollment rates in all educational levels (Komatsu et al. 2017), and in the 1990s the country finally achieved universal primary schooling enrollment (Castro 1998).

The educational composition of the Brazilian population changed over the course of the Twenty century (Fígoli 2006) Women were significantly affected by this educational expansion. At the beginning, females benefited of schooling gains through a sex-stratified educational system, in which they received instruction to operate in specific labor sectors such as health, hospitality and education (Besse 1999). This process affected female labor market status and created wage inequalities between men and women, but it also fostered women the opportunity to leave private spaces (household or family) and to participate more in the public spheres of the society (public spaces such as commerce and labor market) (Azevedo and Ferreira 2006; Maluf and Mott 1998).

In sum, female schooling resulted in the reversion of male educational advantages (Beltrão and Alves 2009), and it has promoted important transformations in gender relations and social norms of the country through the course of the Twenty century (Itaboraí 2015). As results, we saw an increasing participation of women in the labor market (Scorzafave and Menezes-Filho 2001) and their larger attendance in secondary and tertiary education (Godinho et al. 2006). Notwithstanding, higher school enrollments led to significant changes in educational composition of the population (Fígoli 2006), notably for women. Through the course of the country fertility transition, women achieved higher educational gains than men (Beltrão and Alves 2009; Ribeiro and Silva 2009), which endorsed decreases of educational hypergamy (matrimonial profiles in which male partners have higher educational attainment level than their female partners) as consequence (Ribeiro and Silva 2009).

### 2.2 Assortative matching trends in Brazil

The population's assortative matching patterns depends to a great extent on the heterogeneity of social characteristics of its individuals (Blau and Schwartz 1997). Conjugal unions represent an opportunity of social interaction among distinguished social groups, but this interaction depends on the matrimonial market's composition and the size of each group in question (Kalmijn 1998). In this context of study, educational composition of conjugal markets plays an important role and are usually analyzed by demographers due to some important advantages over other socioeconomic indicators such as income. Besides its importance in shaping an individual's life course, preferences and professional realizations, education attainment is usually stable over time for adults. Individual income, on the other hand, is volatile and sensitive to macroeconomic fluctuations (Esteve, Garcia-Román, and Permanyer 2012; Kalmijn 1998; Mare 1991; Warren 1966).

The schools are the environment that shapes social networks among individuals, in which union formation generally takes place (Eckland 1968; Warren 1966). Therefore, the massification of formal education is one of the drivers of the biased (and sometimes unconscious) allocation of couples in matrimonial formation. In general, matrimonial unions take place between people of similar educational levels, due to closer social contact of school classmates and the shared human capital formation (Kalmijn 1998). The college educated couples give a good example of high homogamy (unions of individuals with similar characteristics) rates around the world, since these individuals have spent most of their youth in the educational system with similar peers (Mare 1991), favoring a posterior matrimonial formation.

The educational composition changes in Brazilian society were not only responsible for fertility decline (Lam, Sedlacek, and Duryea 1992),, but it had also major effects on the patterns of the country's assortative matching (Ribeiro and Silva 2009). Both educational hypogamy (couples in which females have higher education level than their partners) and educational hypergamy (couples in which females have lower education level than their partners) increased expressively from 1970 to 2010. Although, educational hypogamy increased at a higher pace due to female accelerated educational gains in the same period considered (Esteve, Garcia-Román, and Permanyer 2012; Esteve and McCaa 2007; Ribeiro and Silva 2009). The prevalence of educational homogamy (couples with the same educational level), on the other hand, has decreased over the time (Esteve and McCaa 2007; Ribeiro and Silva 2009).

In Brazil, the homogamous mating has a major prevalence between lower educated social groups, and its reduction rates can be attributed to the expansion of the country's educational system (Ribeiro and Silva 2009). On the other hand, highly schooled couples also show high educational homogamy rates (Esteve and McCaa 2007; Ribeiro and Silva 2009), and that fact shed light on the existing societal barriers in disfavor of the social interactions between groups of different educational backgrounds (Torche 2010). For this reason, in a context of changing gender norms and diversifying assortative mating profiles, it is essential to consider the characteristics of both partners and to evaluate their role on fertility schedules across societies (Nitsche et al. 2018).

## 2.3 Reproductive decision making and family conflicts

Despite its relevant role in population reproduction, male and female interactions in fertility decision making have been scarcely analyzed in demography (Nitsche et al. 2018). Generally in reproductive studies, males are left out of fertility analysis (Goldscheider and Kaufman 1996; Oliveira, Bilac, and Muszkat 1994; Van Bavel 2017). It happens due to the lack of information on male’s reproductive intentions and behavior in most data (Schoumaker 2019). However, one can argue that males interfere in family size, because of their important role on resource allocation inside the household and in family planning decisions (Thomson 1997). In addition, the evaluation of male’s characteristics in reproduction of couples gains importance in a period of changing in gender relations, cultural norms, family relations and assortative matching patterns.

The Western trend of female schooling expansion, followed by increased demand of women labor force and the reduction of social costs of reproduction, led to the first phase of the Gender Revolution (Goldscheider, Bernhardt, and Lappegård 2015). This phase is marked by the increased participation of women in the public life and institutional spheres (England 2010; Esping-Andersen 2009; Goldin 2006). The second phase of this revolution (yet in course) would be guided by an increase in male's participation in the private sphere, e. g. in household chores and childbearing decisions (Esping-Andersen 2009). An optimistic view of this second phase expects a new balance of gender relations in the near future, with lower constraints to female reproduction and greater commitment of male partners to childbearing and domestic activities (Goldscheider, Bernhardt, and Lappegård 2015; Myrskylä, Kohler, and Billari 2011). Yet, neither the increments in female participation in public spaces nor the higher achieved women schooling levels led to improvements in sexual division of labor within families (England 2010).

In Brazil, the female participation in the labor market resulted in a double burden, especially for the most vulnerable social classes that are unable to acquire domestic and child rearing services from the private market (Guedes 2015; Itaboraí 2016). Moreover, these social constraints induced women to undertake different strategies to conciliate their labor activities with social motherhood responsibilities (household chores and childbearing). For example, they often choose to work on part-time jobs (England 2010; Guedes 2015); they leave formal labor or opt for jobs in the informal market (Teixeira 2014). In contrast to them, high socioeconomic strata women dedicate lower time to household chores, due to their easy access to home care services in the private sector, or because they prefer to invest in their jobs instead of family, or due to the fact that, in general, their highly educated males partners tend to be more active in domestic activities (Itaboraí 2016).

Taking all that into consideration, in the next sections, we will try to analyze past Brazilian cohort fertility developments, using distinguished couples' educational pairings as a tool to measure male's influence on the general family fertility.

## 3. Data and Methods

### 3.1 Data

We use data collected via IPUMS-International from Brazilian National Censuses of 1970, 1980, 1991, 2000 and 2010, conducted by the Brazilian Institute of Geography and Statistics (IBGE, from Portuguese *Instituto Brasileiro de Geografia e Estatística*). The IPUMS data is harmonized in time and space, which allows for comparison of different demographic scenarios and areas without the need for compatibilization (Esteve and Sobek 2003; Minnesota Population Center 2019).

With the available information in the censuses, we have identified the educational level of household members, number of children ever born to each woman in the household and their respective partners. This identification is done through the following variables: household serial number, marital status and relationship with the household head. These three pieces of information permitted us to pair women with their respective partners, and to link the couple's educational attainment level information with the number of children ever born. We used educational attainment levels available in four levels at IPUMS: 1) Less than Primary Education (LP), 2) Complete Primary Education (P), 3) Complete Secondary Education (S) and 4) Complete Tertiary Education (T).

The couples were identified based on the information of each individual marital status and its relationship with the head of the household. We chose to evaluate either formal or consensual unions, because cohabitation historically has spread through diverse social groups in Brazil, and it responds for a non-negligible share of observed fertility levels (Esteve, Garcia-Román, and Permanyer 2012; Laplante et al. 2015; Vieira 2016). Despite the formal matrimonial and the consensual unions are displaying different age-specific fertility profiles (Vieira and Alves 2016) and different fertility levels (Vieira 2016), they do not exhibit significant differentials in terms of assortative mating patterns (Esteve and McCaa 2007).

By taking the difference between census reference period and women age, we could estimate cohort fertility rates (CFR) for Brazil and selected regions. We restricted female ages to the range from 40 to 69 years old, and male ages to the range of 35 to 79. We considered that by the age of 40 years old, women would already have completed or would be close to complete their reproductive cycle. This women's age ranges make it possible to reconstruct cohorts born between the years 1901 until 1970. However, we restrict our analysis to the born cohorts between the years 1925-1969, because of data quality issues related to memory misstatements of number of children ever born among older women (Brass et al. 1968), and due to data contiguity issues for this older cohorts educational groups (Monteiro da Silva 2019). For men, we chose a broader age range to increase the number of couples' observations, allowing males to be older than the women but also to include the couples in which men are younger than their partners.

Improbable and unreliable number of children ever born statements were also addressed prior to the estimation of CFRs. Hence, we assumed that women can bear only one living child each 18 months, starting from age 12 (Moultrie et al. 2013). Following this rule of thumb, at the age of 15 years old, it is expected that women have a maximum of two kids; at 20 years of age, they bore a maximum of five children, and so on. Thus, when the stated number of children ever born exceeded this threshold expected parity, for a given woman's age, we set its value to the maximum expected number of offspring, according to the expected mother's age, following this rule of thumb.

Finally, we also analyzed cohort fertility taken into account the regional socioeconomic disparities of the country, thus, we grouped CRFs into 3 regions: 1) Midwest, 2) South-Southeast and 3) North-Northeast. These groups were chosen based on similar socioeconomic characteristics, shared characteristics of cohort fertility, as well as the assortative mating verified in previous analysis (Monteiro da Silva 2019).This grouping facilitates managing scale issues of small sample sizes in regions of lower population density and lower population counts of particular educational groups. Notwithstanding, the general Brazilian fertility decline also followed this regional grouping (Gonçalves et al. 2019).

### 3.2 Cohort fertility trends of educational pairings

Assuming the mentioned conditions and the educational categories, we estimated cohort fertility rates for each educational pairing profile by

$$(1)\, CFR_{F,M}^{t} = \frac{CHBORN_{F,M}^{t}}{W_{F,M}^{t}},$$

where,

- $CFR_{F,M}^{t}$: Cohort Fertility Rates for cohorts of women born in time t with an educational attainment level F married/in-union with a partner that reached an educational attainment level M;

- $CHBORN_{F,M}^{t}$: Children Ever Born to cohorts of women born in time t with an educational attainment level F married/in-union with a partner that reached an educational attainment level M;

- $W_{F,M}^{t}$: Total number of women from the cohort born in time t with an educational attainment level F married/in-union with a partner that reached an educational attainment level M.

We compute CFRs in two ways for different methodological evaluations. First, we estimate CFRs for each educational pairing of women born cohorts, ranging from the years 1925-1969, grouped in five-year age groups and educational levels LP, P and S+ (secondary or tertiary education completed). The last two educational levels were grouped in order to avoid small sample size problems and noise CFRs estimates, due to few people with tertiary educational attainment levels from older cohorts.

The CFR trends were then evaluated in terms of both males' and females' educational attainment levels, as a way to visualize how each partner's schooling influences Brazilian regional fertility developments.

### 3.3 Decomposition of CFRs by educational pairing

In a second moment, we computed CFR for three female cohorts corresponding to a 15 year time interval. We divided these cohorts according to phases of schooling expansion, for men and women, and their correspondent fertility transition phase as described below:

- Cohorts born between the years 1925-39: older female cohorts, forerunners of the processes of fertility decline in the country and they have experienced the intensification of female schooling (Azevedo and Ferreira 2006);

- Cohorts born between the years 1940-54: women born in a period of educational system expansion and who are still presenting lower schooling levels than men (Beltrão and Alves 2009). These women, however, responded for a large share of fertility decline in decades of 1960-80, influenced by the diffusion of modern contraceptive methods (Carvalho and Wong 1992; Goldin and Katz 2002; Merrick and Berquó 1983);

- Cohorts born between the years 1955-1969: younger female cohorts that have achieved higher schooling levels than men, and have experienced higher labor market participation rates than previous female cohorts (Beltrão and Alves 2009; Lam, Sedlacek, and Duryea 1992; Scorzafave and Menezes-Filho 2001).

Taking more cohorts into consideration made it possible to evaluate even the tertiary education influence on cohort fertility, and decompose the effects of educational expansion and changing conjugal profiles in fertility by comparing each cohort group separately. We apply a demographic decomposition method (Das Gupta 1993), performed by Yoo (2014), to assess both influence of educational pairings (*composition effects*) and cohort (*rate effects*) on fertility differentials ( $\Delta CFR$ ).

The overall CFR for a given period T is computed by

$$(2)\, CFR^{T} = \sum_{i}^{ep} CFR_{ep}^{T} P_{ep}^{T}.$$

Further, the differences in CFR from time T1 to time T2 are given by

$$(3)\, \Delta CFR_{12} = CFR^{T1} - CFR^{T2} = \sum_{i}^{ep} CFR_{ep}^{T1} P_{ep}^{T1} - \sum_{i}^{ep} CFR_{ep}^{T2} P_{ep}^{T2},$$

where,

- $T$ is the female cohort birth period that assume 3 cohort intervals: T = {1925-39, 1940-54, 1955-69};

- $ep$ is the educational pairing profile, which assumes 16 possible combinations of female and male educational levels (F,M): ep = {(LP,LP), (LP,P), (LP,S), (LP,T), (P,LP), (P,P), (P,S), (P,T), (S,LP), (S,P), (S,S), (S,T), (T,LP), (T,P), (T,S), (T,T)};

- $P_{ep}^{T}$ is the proportion of education paired couples for female cohort $T$ with an $ep$ profile.

The cohort fertility differences are estimated pairwise, i.e., between female cohorts born in 1925-39 and 1940-54, between 1940-54 and

1955-69 cohorts, comparing cohorts from 1925-39 to 1955-69. These cohort fertility differentials can be decomposed in compositional effects of marriage markets, which are related to changes in educational pairings distribution, and rate effects, related to changes in CFR specific for each educational pairing (see Das Gupta (1993:37) for details on decomposition of rates as functions of two vector-factors). Therefore:

$$(4) \quad \Delta CFR_{1,2} = \Delta CFR_{1,2}^{effect} + \Delta P_{1,2}^{effect}.$$

We can evaluate compositional differences in terms of changing matrimonial educational profiles among female cohorts and the other unobserved effects that affect CFRs among each educational profile of couples.

### 3.4 Limitations of analysis

The national census data have some limitations for our methodological approaches. First, they do not provide information about the duration of past unions and their influence on reproductive levels of women. Thus, we assume that women conceived all the declared children (or most of them) inside the matrimonial unions reported at the time of the census inquiries. An increase in the number of divorces (or re-marriages) through time in Brazil is likely to influence our estimates (Camarano 2014:146). However, the union dissolution rates in the country have been considerably stable at the low values of 0.5 and 1%, from the 1980s until the beginning of the 2000s (IBGE 2014), which in turn causes little harm to our analyses.

Second, only cohabiting couples from the same household are considered in the estimates, because the Brazilian censuses do not allow the construction of family ties from different households. Therefore, usually for economic reasons, couples may live apart, a feature commonly observed in the Northeast region (Maluf and Mott 1998), and we may miss some reproductive information of women whose partners were not living in the same household, during the census inquiries. Actually, this migration effect in lower developed areas is higher for cohorts born in periods of intense migration flows, from North-Northeast in direction to Southeast region, as a result of the industrialization process (Singer 1973). We tried to reduce this migration effect by grouping the geographical areas into big regions. Notwithstand, the period of intense migration flow from rural Northern to urban Southern areas in the country ended 1960 (Baeninger 2012), affecting mostly the older cohorts born from 1925-39. Even though, as expected, these last cohorts are still presenting the highest levels of fertility in the North-Northeast regions compared to the rest of the country, meaning that migration might affect the fertility education pairing estimates, but this effect is not too big.

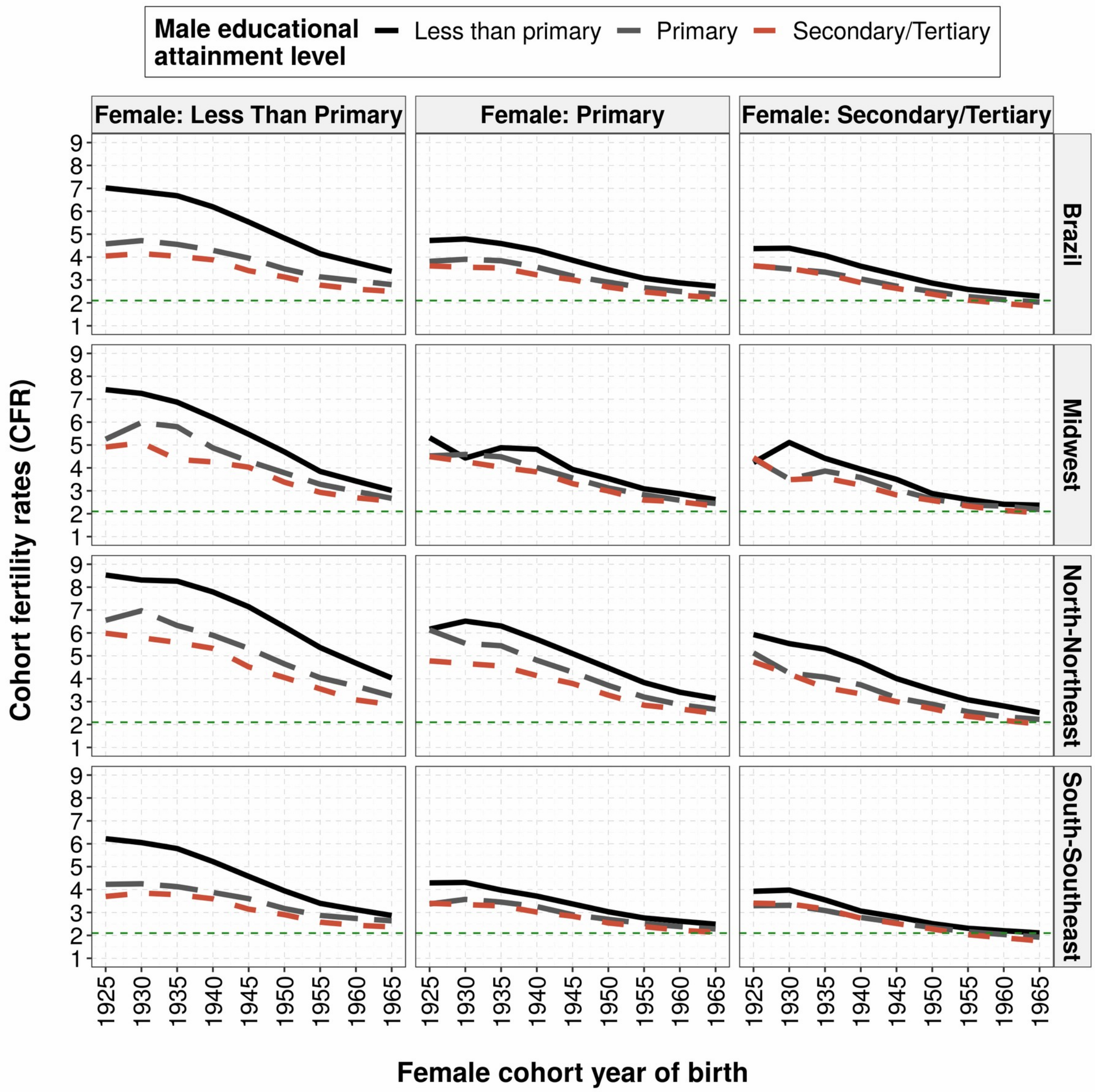
## 4. Results

### 4.1 Educational pairings cohort fertility trends in Brazil

First we turn our attention to analyze cohort fertility trends of educational pairings, following the CFRs of five-year grouped female cohorts for Brazil and its regions (Figure 1). Each panel of Figure 1 presents a fixed educational attainment level for females and each line represents the male partner’s educational attainment level. The distances between lines of the same graph (panel) represent fertility differentials among male partners’ educational categories, i.e., the effect of male schooling in cohort fertility.

For the country as a whole, we observe marked fertility differentials for both male and female partners. For older female born cohorts, couples with at least one partner without complete primary school presented higher fertility levels than other pairings. Male partners’ low educational levels seem to have contributed to the slow down of the fertility transition in Brazil. However, increasing female education across cohorts has minimized differences in CFR between male partner’s educational categories and it has induced fertility reductions (Merrick and Berquó 1983). Female education increases bargaining power and autonomy of women in family decision making (Jejeebhoy 1995). Therefore, high schooled women have reproductive profiles less attached to their husband’s educational characteristics and more related to females own socioeconomic status and perceived opportunity costs of reproduction (Becker 1993).

Figure 1: Educational pairings cohort fertility trends for female birth cohorts grouped in five-year intervals for Brazil and regions.




*Source:* Brazilian national censuses 1970, 1980, 1991, 2000, 2010.

The Midwest region presented a CFR transition similar to the one observed for the country as a whole. In this region, male schooling influenced more fertility of old cohorts commonly composed by women with low education. Additionally, as women achieved higher schooling levels, the effects of partner's educational differentials diminished, and CFRs got closer to replacement fertility levels. Younger cohorts exhibit similar CFR values for all educational categories of the partner and converge towards population replacement levels.

In the North and Northeast regions, cohorts started their CFRs reductions from rates above 8 children per woman among low educated groups. In these regions, we observed important differentials of male partner's fertility between the educational categories, especially for those in transition from incomplete to complete primary education. The increase of females' educational levels in North-Northeast areas induced a general fertility reduction, but this was not followed by a decrease in the effects of male partner's educational differentials on CFRs at the same pace as observed in other regions. Hence, the observed results for couples in which males have the lowest schooling level are at higher CFR levels than others.

South and Southeast areas started their cohort fertility transition from lower CFR levels relative to other areas of the country. i.e. the rates show less than 6 children per woman for those with incomplete primary education. In contrast to lesser developed regions of the country, male education affected less changes in cohort fertility, that is observed even among cohorts of women with incomplete primary school - curves are close to each other specially for younger cohorts. These regions also present the stronger convergence process of CFRs towards replacement levels. All couples with low educated females show CFR lower than 3 children per woman. Next, we will investigate the changes in cohort fertility differentials by decomposing this measure between the effects of educational pairings on CFRs and the effects on cohort fertility of any other variable not observed.

### 4.2 Decomposition of cohort fertility rates

Tables 1 to 4 present the percentage share of educational pairings and the estimated CFRs for female cohorts born in 1925-39, 1940-54 and 1955-69 for Brazil and its regions.

Table 1: Educational pairings prevalence rates and cohort fertility rates for female cohorts born in 1925-39, 1940-54 and 1955-69 - Brazil. Source: Brazilian National Censuses, 1970, 1980, 1991, 2000, 2010.

| Education | | Prevalence (%) | | | CFR | | |
|---|---|---|---|---|---|---|---|
| Female | Male | 1925-1939 | 1940-1954 | 1955-1969 | 1925-1939 | 1940-1954 | 1955-1969 |
| LP | LP | 80.87 | 62.17 | 36.59 | 6.84 | 5.52 | 3.87 |
| LP | P | 4.01 | 5.47 | 6.65 | 4.61 | 3.85 | 2.99 |
| LP | S | 1.70 | 2.22 | 2.28 | 4.13 | 3.47 | 2.67 |
| LP | T | 0.56 | 0.48 | 0.26 | 3.91 | 3.28 | 2.47 |
| P | LP | 2.34 | 5.08 | 8.60 | 4.68 | 3.76 | 2.91 |
| P | P | 1.95 | 4.22 | 9.57 | 3.85 | 3.12 | 2.51 |
| P | S | 1.18 | 2.17 | 4.02 | 3.64 | 2.95 | 2.38 |
| P | T | 0.84 | 0.86 | 0.77 | 3.45 | 2.85 | 2.22 |
| S | LP | 1.20 | 2.56 | 3.76 | 4.31 | 3.25 | 2.50 |
| S | P | 0.82 | 1.92 | 4.46 | 3.54 | 2.76 | 2.20 |
| S | S | 1.49 | 4.06 | 9.15 | 3.39 | 2.64 | 2.09 |
| S | T | 1.43 | 2.60 | 2.97 | 3.54 | 2.69 | 2.06 |
| T | LP | 0.21 | 0.59 | 0.79 | 3.71 | 2.67 | 2.23 |
| T | P | 0.19 | 0.67 | 1.31 | 3.07 | 2.42 | 1.98 |
| T | S | 0.33 | 1.50 | 3.21 | 3.18 | 2.36 | 1.86 |
| T | T | 0.88 | 3.45 | 5.60 | 3.29 | 2.45 | 1.86 |

*Source:* Brazilian national censuses 1970, 1980, 1991, 2000, 2010.

Table 2: Educational pairings prevalence rates and cohort fertility rates for female cohorts born in 1925-39, 1940-54 and 1955-69 - Midwest region.

| Education | | Prevalence (%) | | | CFR | | |
|---|---|---|---|---|---|---|---|
| Female | Male | 1925-1939 | 1940-1954 | 1955-1969 | 1925-1939 | 1940-1954 | 1955-1969 |
| LP | LP | 83.70 | 62.63 | 34.89 | 7.15 | 5.45 | 3.54 |
| LP | P | 2.90 | 4.73 | 6.21 | 5.75 | 4.21 | 3.00 |
| LP | S | 1.16 | 1.73 | 1.93 | 4.83 | 3.83 | 2.74 |
| LP | T | 0.40 | 0.38 | 0.25 | 4.29 | 3.81 | 2.69 |
| P | LP | 2.28 | 5.66 | 9.42 | 4.82 | 3.91 | 2.88 |
| P | P | 1.67 | 3.91 | 9.44 | 4.52 | 3.42 | 2.61 |
| P | S | 0.94 | 1.92 | 3.75 | 4.38 | 3.36 | 2.51 |
| P | T | 0.81 | 0.68 | 0.77 | 3.99 | 3.12 | 2.39 |
| S | LP | 1.11 | 2.98 | 4.41 | 4.72 | 3.38 | 2.51 |
| S | P | 0.72 | 2.06 | 4.80 | 4.16 | 3.01 | 2.33 |
| S | S | 1.15 | 3.84 | 8.63 | 3.94 | 2.90 | 2.26 |
| S | T | 1.39 | 2.55 | 3.05 | 3.68 | 2.90 | 2.22 |
| T | LP | 0.22 | 0.67 | 1.09 | 3.87 | 2.88 | 2.32 |
| T | P | 0.21 | 0.79 | 1.63 | 2.86 | 2.68 | 2.19 |
| T | S | 0.32 | 1.65 | 3.57 | 3.72 | 2.58 | 2.06 |
| T | T | 1.02 | 3.82 | 6.17 | 3.35 | 2.63 | 2.08 |

*Source:* Brazilian national censuses, 1970, 1980, 1991, 2000, 2010.

Table 3: Educational pairings prevalence rates and cohort fertility rates for female cohorts born in 1925-39, 1940-54 and 1955-69 - North-Northeast regions.

| Education | | Prevalence (%) | | | CFR | | |
|---|---|---|---|---|---|---|---|
| Female | Male | 1925-1939 | 1940-1954 | 1955-1969 | 1925-1939 | 1940-1954 | 1955-1969 |
| LP | LP | 89.30 | 73.99 | 48.47 | 8.36 | 7.07 | 4.85 |
| LP | P | 2.02 | 3.38 | 5.10 | 6.59 | 5.18 | 3.68 |
| LP | S | 0.78 | 1.27 | 1.67 | 5.91 | 4.56 | 3.22 |
| LP | T | 0.22 | 0.18 | 0.15 | 5.22 | 4.39 | 2.88 |
| P | LP | 1.78 | 4.43 | 8.76 | 6.34 | 4.93 | 3.48 |
| P | P | 1.02 | 2.40 | 6.61 | 5.63 | 4.11 | 2.89 |
| P | S | 0.62 | 1.26 | 2.79 | 4.80 | 3.68 | 2.70 |
| P | T | 0.33 | 0.31 | 0.40 | 4.33 | 3.49 | 2.42 |
| S | LP | 1.01 | 2.79 | 4.54 | 5.51 | 4.04 | 2.86 |
| S | P | 0.54 | 1.58 | 4.08 | 4.42 | 3.23 | 2.40 |
| S | S | 0.87 | 3.17 | 7.96 | 4.26 | 3.01 | 2.26 |
| S | T | 0.64 | 1.33 | 1.84 | 3.99 | 3.07 | 2.28 |
| T | LP | 0.15 | 0.48 | 0.92 | 5.21 | 3.25 | 2.59 |
| T | P | 0.11 | 0.44 | 1.07 | 3.78 | 2.73 | 2.24 |
| T | S | 0.20 | 1.13 | 2.42 | 3.62 | 2.65 | 2.06 |
| T | T | 0.40 | 1.85 | 3.23 | 3.54 | 2.78 | 2.07 |

*Source:* Brazilian national censuses, 1970, 1980, 1991, 2000, 2010.

Table 4: Educational pairings prevalence rates and cohort fertility rates for female cohorts born in 1925-39, 1940-54 and 1955-69 - South-Southeast regions.

| Education | | Prevalence (%) | | | CFR | | |
|---|---|---|---|---|---|---|---|
| Female | Male | 1925-1939 | 1940-1954 | 1955-1969 | 1925-1939 | 1940-1954 | 1955-1969 |
| LP | LP | 76.80 | 56.61 | 31.32 | 6.01 | 4.59 | 3.22 |
| LP | P | 5.00 | 6.52 | 7.42 | 4.20 | 3.50 | 2.77 |
| LP | S | 2.16 | 2.71 | 2.61 | 3.81 | 3.21 | 2.50 |
| LP | T | 0.73 | 0.63 | 0.32 | 3.71 | 3.09 | 2.37 |
| P | LP | 2.60 | 5.33 | 8.44 | 4.16 | 3.29 | 2.65 |
| P | P | 2.39 | 5.10 | 10.95 | 3.47 | 2.88 | 2.40 |
| P | S | 1.45 | 2.61 | 4.61 | 3.37 | 2.76 | 2.28 |
| P | T | 1.07 | 1.13 | 0.94 | 3.29 | 2.75 | 2.16 |
| S | LP | 1.30 | 2.41 | 3.32 | 3.85 | 2.81 | 2.27 |
| S | P | 0.96 | 2.07 | 4.60 | 3.27 | 2.56 | 2.10 |
| S | S | 1.81 | 4.49 | 9.76 | 3.17 | 2.49 | 2.00 |
| S | T | 1.79 | 3.20 | 3.48 | 3.46 | 2.60 | 1.99 |
| T | LP | 0.23 | 0.63 | 0.70 | 3.25 | 2.44 | 1.99 |
| T | P | 0.23 | 0.76 | 1.39 | 2.93 | 2.31 | 1.86 |
| T | S | 0.39 | 1.66 | 3.53 | 3.04 | 2.25 | 1.77 |
| T | T | 1.09 | 4.16 | 6.62 | 3.24 | 2.37 | 1.79 |

*Source:* Brazilian national censuses, 1970, 1980, 1991, 2000, 2010.

In general, we verify that educational homogamy reduced its share in all regions of the country. The reasons are linked to decreases in prevalence rates of $LP_{male}$-$LP_{female}$ educational pairings. For women born in 1925-39, approximately 81% were from the lowest schooling level and married with males from this same educational level. This number declined to 37% for females from 1955-69 birth cohorts, as an effect of compositional changes in population’s education. On the other hand, educational homogamy has increased among couples with tertiary education, from less than 1% in 1925-39 cohorts to 5.60% in 1955-69 birth cohorts, a modest increment to outnumber the share percentage of couples with incomplete primary education. Therefore, educational pairings in the country dispersed among higher education categories as the educational expansion was taking place.

When we look at specific regions then different trends in educational pairing composition appears. The Midwest once more shows a similar pattern as Brazil, changing from a past high percentage of homogamous couples with low schooling to more diverse partner profiles and higher prevalence of hypogamic couples among younger cohorts.

In the North-Northeast regions we see the slowest changes in matrimonial profiles. There is a persistent high percentage of low schooled couples in union and the heterogamy share is modest in percentages. In fact, the low educated couples responded for almost 49% of educational pairings for 1955-69 female born cohorts in these regions. Additionally, hypogamic unions were already on the rise for intermediate cohorts, because the females from North-Northeast have overtaken men’s educational levels earlier than in other regions (Monteiro da Silva 2019). This lagged process of homogamy decrease and more hypogamic unions instead can be partially attributed to the historical socioeconomic inequalities of the country. For instance, these Northern areas presented a later shift to an industrial and service based economy relative to the rest of Brazil.

The more developed Southern areas of the country observe an intense process of compositional changes in educational pairings. These areas present the lowest country’s percentage of homogamous unions between less educated couples (around 31% for younger cohorts), and at the same time a later process of increase in hypogamic unions. These regions benefited the most from Brazil’s educational expansion and, therefore, they showed the highest increase of heterogamous couples’ prevalence rates.

Table 4 also portraits important information on fertility differentials among educational groups and female birth cohorts. For old cohorts composed in general by low educated females, when men have complete tertiary education, the CFRs are 2.3 to 3 children per woman smaller as compared to couples formed by males without complete primary education. When we observe the CFR values for opposite arrangements (e.g. men with less than primary education in union with highly educated women), we verify fertility levels close to the ones observed for tertiary educated males. In other words, high male education does also affect couples’ CFR, and in the case of higher education, this effect is almost similar between each partner.

Table 5 presents the overall CFR for these three cohorts for each region and also the results of the decomposition exercises. Brazilian couple's CFRs dropped from 6.30 to 2.94, from the oldest to the youngest female cohorts. The highest decrease was observed in North-Northeast regions, which we observe an expressive reduction in CFRs, from 8.04 to 3.79. Yet, they started their fertility transition process from higher levels and later than other areas, hence, they still presente the highest CFRs for younger cohorts (the value of 3.79 compared to 2.86 of Midwest and 2.55 of South-Southeast).

Table 5: Overall cohort fertility rates and decomposition of rates in CFR and Pairing Composition effects for female birth cohorts born in 1925-39, 1940-54, 1955-69 - Brazil and regions.

| | **Brazil** | **Midwest** | **North-Northeast** | **South-Southeast** |
|---|---|---|---|---|
| | 1.68 (100.00%) | 1.8 (100.00%) | 2.46 (100.00%) | 1.29 (100.00%) |
| **CFR(1925-1939)** | 6.30 | 6.72 | 8.04 | 5.47 |
| **CFR(1940-1954)** | 4.61 | 4.66 | 6.25 | 3.84 |
| **CFR(1955-1969)** | 2.94 | 2.86 | 3.79 | 2.55 |
| CFR(1925-1939) - CFR(1940-1954) | 1.69 (100.00%) | 2.06 (100.00%) | 1.79 (100.00%) | 1.63 (100.00%) |
| CFR Effect | 1.17 (69.23%) | 1.52 (73.79%) | 1.29 (72.07%) | 1.19 (73.01%) |
| **Pairing Composition Effect** | 0.52 (30.77%) | 0.53 (25.73%) | 0.5 (27.93%) | 0.44 (26.99%) |
| CFR(1925-1939) - CFR(1955-1969) | 3.36 (100.00%) | 3.86 (100.00%) | 4.25 (100.00%) | 2.92 (100.00%) |

| | Brazil | Midwest | North-Northeast | South-Southeast |
|---|---|---|---|---|
| CFR Effect | 2.35 (69.94%) | 2.9 (75.13%) | 3.16 (74.35%) | 2.11 (72.26%) |
| **Pairing Composition Effect** | 1.01 (30.06%) | 0.96 (24.87%) | 1.1 (25.88%) | 0.81 (27.74%) |
| CFR Effect | 1.15 (68.45%) | 1.35 (75.00%) | 1.78 (72.36%) | 0.92 (71.32%) |
| Pairing Composition Effect | 0.52 (30.95%) | 0.46 (25.56%) | 0.69 (28.05%) | 0.37 (28.68%) |

*Source:* Brazilian national censuses, 1970, 1980, 1991, 2000, 2010.

In general, for Brazil and its regions, most of the reduction of conjugal CFRs were driven by unobservable effects of rate decline (70%). The remaining 30% of CFR decline among older and younger cohorts are explained by changes in educational pairing composition. This means that a substantial part of the cohort fertility decline of the country occurred as a result of educational expansion, and due to the effects of more schooling not only for women, but also for men. This compositional effect is to great extent explained by the reduction of low educated homogamous couples.

## 5. Discussion and conclusions

Cohort fertility rates display educational pairing differentials between male and female educational categories. In particular, the couples composed by parents with low education, they present the highest cohort fertility levels, especially for older female cohorts. These CFRs' values diminished along female cohorts and between males' educational categories, even controlling for the female's educational levels. Thus, we observed significant evidence that the male partner's education effects on fertility are not negligible, and it influenced the general reduction of cohort fertility levels of the country.

In addition, these fertility differentials among educational categories of men and women diminishes among young female cohorts. We argue that this converging fertility trend is a result of multiple factors. First, the reduction of illiteracy (Fígoli 2006) itself plays a key role in reproductive control adoption (Castro-Martin and Juarez 1995; Perpétuo and Wajnman 1998; Perpétuo and Wong 2009), however, it does not necessarily result in individuals finishing primary school. Second, unexpected effects of institutional reforms of the Brazilian state, between 1970-1990 decades, fostered changes in social and cultural norms of the Brazilian society, which in turn increased female autonomy in family planning (Faria 1989, 1997; Martine 1996). This transformations in Brazilian society were related to the development of a communications system infrastructure, which connected distant regions of the country and contributed for the diffusion of higher social strata reproductive behavior through soap operas (Faria and Potter 1999; La Ferrara, Chong, and Duryea 2012), and to the medicalization of female population, which led to higher adoption of contraceptive methods, even by the most vulnerable social groups (Faria 1997; Martine 1996; Perpétuo and Wajnman 1998; Perpétuo and Wong 2009).

The regional disparities we observed follows the historical patterns of socioeconomic inequalities. North-Northeast regions showed the highest CFR levels among all educational pairings. For instance, they also presented higher and steady differentials among educational pairings, even for higher educated women. We speculate that female reproductive autonomy in these regions are lower or they present lower opportunity costs to reproductive control (Becker 1993; Jejeebhoy 1995), and thus, the partner's education acts as an important driver of fertility control inside the family by a higher involvement of educated males in family planning decisions (Oliveira, Bilac, and Muszkat 2002). Furthermore, the converging trends of fertility levels of pairings with lower educated males is weaker in these areas. A possible explanation is that these regions were not completely integrated to the new urban-industrial economy that was established in São Paulo, due to their export-agricultural roots and ruling local elites (Merrick and Graham 1981; Singer 1973). In this sense, we observe lower formal labor market engagement of women in these areas (Barbosa 2014; Gonçalves, Perez, and Wajnman 2004), which resulted in lower social constraints to reproduction (Patarra and Oliveira 1988). We may say that the North and Northeast were under influence of a patriarchal family model (Aguiar 2000), characterized by lower participation of women in the public sphere of society and lower autonomy in family planning decisions, consequently resulting in higher fertility levels (Becker 1993; Folbre 1994).

On the other hand, Southern regions exhibited the lowest CFR levels and the lowest differentials among educational pairings for all cohorts. The differences between educational pairings CFRs were even smaller for couples with higher educated females, which converged faster towards replacement fertility levels. This seems to be a result of school expansion (reduction of illiteracy) and faster transition of economy to the urban-industrial model, centered in the São Paulo area, which demanded more educated labor force and female participation in the labor market (Romanelli 1986; Singer 1973). As these processes took off in São Paulo state, these areas of the country were the first ones to experience fertility decline due to new rising social norms of urban centers (Gonçalves et al. 2019; Guzmán and Rodríguez 1993). Additionally, for the lower educational level groups, the years of schooling range from 0 to 8. Since Southern areas present the lowest illiteracy rates of the country for older cohorts (Castro 1998), the lower

CFR levels are reflected in higher literacy rates in these regions. Finally, younger female cohorts with complete secondary school show below replacement fertility levels, independently of the partner’s educational level, once more supporting the argument that education favors female reproductive autonomy (Jejeebhoy 1995).

In addition, the educational pairing composition changed significantly through cohorts. Homogamy was high in the past, because of the overall lower levels of education of the population (Esteve and McCaa 2007; Ribeiro and Silva 2009). Additionally, as women benefited the most from educational expansion (Beltrão and Alves 2009), Brazil observed considerable compositional changes in population education levels (Fígoli 2006), and the prevalence of hypogamic couples rose significantly over the period as hypergamy showed a steady decline (Esteve et al. 2016). As a consequence, the disparities in terms of educational pairing among Northern and Southern regions kept marked. The Southern area was a forerunner of the educational expansion in the country, because it experienced first the industrialization process of Brazil (Komatsu et al. 2017; Romanelli 1986). The industrial labor market was male-dominated (Teixeira 2014) and it required technical skills achieved through professional education (Romanelli 1986). Hence, the highly educated male population of the Southern regions resulted in the later process of hypogamy increase.

The slow pace of decreasing low education homogamic couples, common in the North-Northeast regions, was the result of a belated educational expansion. However, these areas also displayed a faster transition towards hypogamy than others. In these regions, there was a lower market demand for schooling of the usually male workers in the primary industrial sector who, due to income inequalities, had few alternatives rather than working in the informal lower paid markets (Merrick and Graham 1981; Romanelli 1986; Wood and Carvalho 1988). On the other hand, women had easier access to schooling, since they usually performed household or professional activities that were more compatible with formal education, such as teacher formation schools (Azevedo and Ferreira 2006; Guedes 2015).

In a decomposition exercise, we estimated that 30% of the cohort fertility decline between forerunners of fertility transition cohorts (female cohorts born in 1925-39) and medium-low fertility cohorts (female cohorts born in 1955-69) were a result of changes in educational pairing composition. For this reason, we argue that educational attainment contributes for both males and females attitudes towards family planning and fertility control. In this sense, male's educational attainment also contributes for fertility reduction, since higher education means more commitment of men to household activities (Esping-Andersen 2009; McDonald 2000), and this lowers in turn constraints to female reproduction and promotes the fulfillment of fertility intentions (Folbre 1994). In regions where the education expansion of males lagged in relation to others (as example the North-Northeastern parts of the country), the fertility transition was slower and females reproductive autonomy was also weaker, due to cultural aspects and prevailing patriarchal social norms of the region in the past (Aguiar 2000; Folbre 1983). In sum, we may say that the slower educational expansion for men in the less developed areas of the country might have delayed the fertility transition in the country, especially in locations where men lagged in educational attainment levels in relation to women.

It is important to mention that the lack of information of union histories lead to the main limitation of our analysis: all children reported by women are linked to current unions' partners. Also, CFRs are likely to be underestimated due to differential mortality among educational categories (Silva, Freire, and Pereira 2016). Yet, this work brings major contributions to Brazilian fertility analysis and provides important insights on men's role in the fertility transition process. First of all, the use of a cohort approach is novel in demographic analysis of the country. In addition, we address male's educational characteristics within couples and we take into account the regional differences in terms of educational expansion and economic development. We expect this paper foments new studies on male's role in reproductive intentions and behavior of Brazilian families.

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