

Fertility Transition in Brazilian Municipalities: An Exploratory Analysis of Cross-sectional Data in 1991, 2000 and 2010

Transición de la fecundidad en municipios brasileños: un análisis exploratorio de datos transversales en 1991, 2000 y 2010

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Abstract

Understanding the fertility transition in Brazil at the municipal scale provides important support for designing and implementing local policies that incorporate spatial heterogeneity into local sociodemographic dimensions. To analyze the heterogeneity of the fertility transition process among Brazilian municipalities over the last two decades, we rewrite the logistic curve equation, estimate the parameters of the

Keywords

Fertility Transition
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national logistic curve and allocate Brazilian municipalities in the national trend using their own total fertility rates. The lag between most and least developed areas persists in either the North or Northeast Region, opposite to what is observed in the South and Southeast. While some municipalities are beyond their time regarding the national average fertility transition, others are at the beginning of the transition. The very fast fertility decline experienced by late runners in the more recent period results in changes in age composition, configuring a challenge that social decision-makers should face.

Resumen

Comprender la transición de la fecundidad en Brasil a escala municipal proporciona un apoyo importante para quien diseña e implementa políticas locales que incorporen la heterogeneidad espacial en las dimensiones sociodemográficas locales. Para analizar la heterogeneidad del proceso de transición de la fecundidad entre los municipios brasileños durante las últimas dos décadas, reescribimos la ecuación de la curva logística, estimamos los parámetros de la curva logística nacional y ubicamos los municipios brasileños en la tendencia nacional utilizando sus propias tasas globales de fecundidad. El rezago entre las áreas más y menos desarrolladas persiste tanto en la Región Norte como en la Nordeste, al contrario de lo que se observa en la Región Sur y Sudeste. Mientras que algunos municipios están más allá de su tiempo en términos del promedio de la transición de fecundidad nacional, otros están al comienzo de la transición. El declive muy rápido experimentado por los que se retrasaron en el periodo más reciente resulta en cambios en la composición por edades y configura un desafío que los tomadores de decisiones sociales deben enfrentar.

Palabras clave

Transición de la fecundidad
Ecuación logística
Heterogeneidad
Áreas pequeñas
Brasil

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Introduction

The literature usually defines demographic transition as a shift from high mortality and fertility rates to lower rates (Lee, 2003; Notestein, 1945). In other words, the demographic transition is the change from high to low-pressure demographic regimes (Moreda, & Reher, 1986).

This topic has long been addressed, and several explanatory factors have already been identified as determinants for the onset, time, and pace of the fertility decline. The variables most commonly indicated as determinants

are infant and child mortality decline, increase in the cost of raising children, secularization, increment in the female labor market, and spread of contraceptive use. Changes in reproductive preferences, intergenerational transfer flows, cultural values, and gender relations, among other aspects, are also mentioned (Becker, 1981; Bongaarts, & Watkins, 1996; Caldwell, 1976; Cleland, & Wilson, 1987; Coale, 1973; Easterlin, & Crimmins, 1985; McDonald, 2000a, 2000b; Notestein, 1945, 1953).

However, the transition is not homogeneous. It started in more developed regions, urban areas, and among the more educated and older women – since fertility control typically occurred in high-order parities (Kirk, 1996; Knodel, & Van De Walle, 1979). It is also true that demographic transition also operates in less privileged societies, where it has often been faster and later.

Two theoretical approaches motivate this paper: the cultural and, particularly, diffusional or social interaction (Bongaarts, & Watkins, 1996; Cleland, 1998; Cleland, & Wilson, 1987). According to the former, if fertility falls first in a given setting, it will also fall in areas with the same cultural background and language but with a time lag. In this context, the expansion of parental education and the entry of women into the labor market contribute to the onset of the fertility transition. The more homogeneous the population, the sharper the fertility will decline (Cleland, & Wilson, 1987).

According to the latter, spreading knowledge on contraception is the key factor for the onset and pace of fertility decline. Its speed depends on the diffusion of contraception knowledge through different women's social classes. Therefore, the influence of the behavior diffusion agent on their peers is especially determinant in accelerating knowledge. Furthermore, the type of network where the individuals are inserted determines how the knowledge will spread; the more homogenous the networks, the greater the spread (Bongaarts, & Watkins, 1996). Therefore, once fertility control establishes, the downward trend is irreversible.

Despite these different but complementary approaches, we analyze the heterogeneity of the fertility transition process among Brazilian municipalities in 1991, 2000, and 2010 (years of the last three Brazilian censuses). We follow three stages. First, we estimate the parameters of the logistic curve for Brazil using its fertility trend from 1930 to 2010, estimated previously by other authors. Second, we allocated each municipalities' Total Fertility Rate (TFR) in the time trend of national fertility, assuming that municipalities will follow the same trend or have followed it in the past. It is an unrealistic assumption, as will be explained later, but allow us to point out some important conclusions. Third,

we classify each municipality's fertility moment on the three-demographic census in four different categories: pre-transition, acceleration transition, deceleration transition, and below the replacement level.

Analysis according to small areas incorporates the heterogeneity and specificities of the relationship between fertility and social/cultural issues throughout space (Horta, Carvalho, & Nogueira, 2005; Muniz, 2009) and uncovers the great demographic heterogeneity hidden in such a large country like Brazil (Potter et al., 2010). Therefore, this disaggregation level is needed to elaborate and implement local social policies and contributes to substantiating hypotheses about the level and pattern of fertility in population projections for small areas.

The results show a convergent process of the fertility transition timing by municipalities in Brazil, with different speeds though being faster in areas with higher fertility, i.e., the North and Northeast of the country. While several municipalities were in the pre-transition stage of fertility transition in the demographic census from 1991, especially in the North and in the Northeast of Brazil, this situation disappeared in 2010, when the same municipalities were converging to a low fertility stage. The same procedure can be replicated in other countries and regions where the data for small areas are available.

Background – Brazilian context

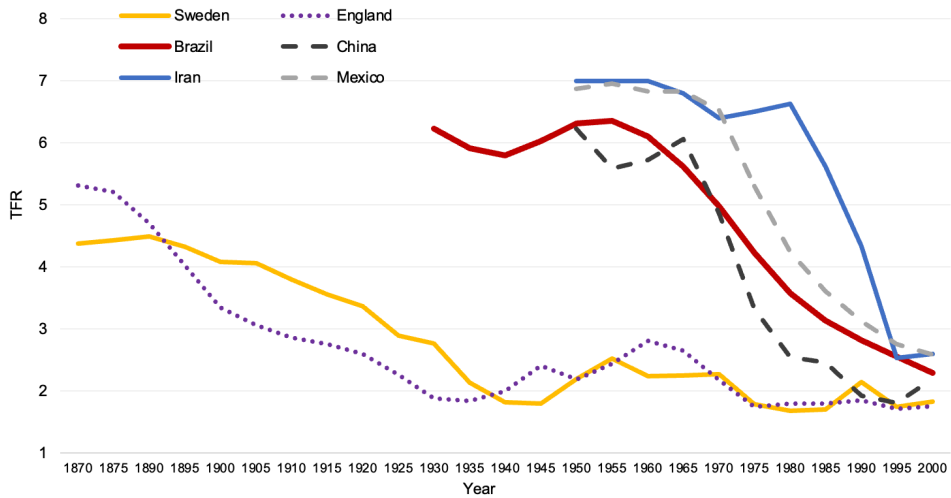
Brazil has endured, throughout history, significant social and economic inequality that characterizes its Macroregions, being the North and Northeast the most vulnerable settings compared to the South and Southeast Regions. Figure 1A shows the Human Development Index (HDI) in these Regions as an illustration of the inequality.

The Brazilian fertility decline is similar to that of several developing countries relating to its recent trend. At the same time diverges from developed settings (Figure 1a). However, Brazilian fertility transition has not been homogeneous, considering timing or pace, throughout its Regions encompassing more than 5,000 municipalities.

The fertility transition in Brazil began in the third decade of the 20th century, as it has been demonstrated by Frias and Oliveira (1991), Frias and Carvalho (1992), Horta, Carvalho, and Frias (2000). Quaresma (2019), using 10 Macroregions also demonstrates the great regional heterogeneous timing trend (Figure 1b). The first phase of the Brazilian fertility transition had a slow pace, similar to what was observed in Europe at the end of the 19th

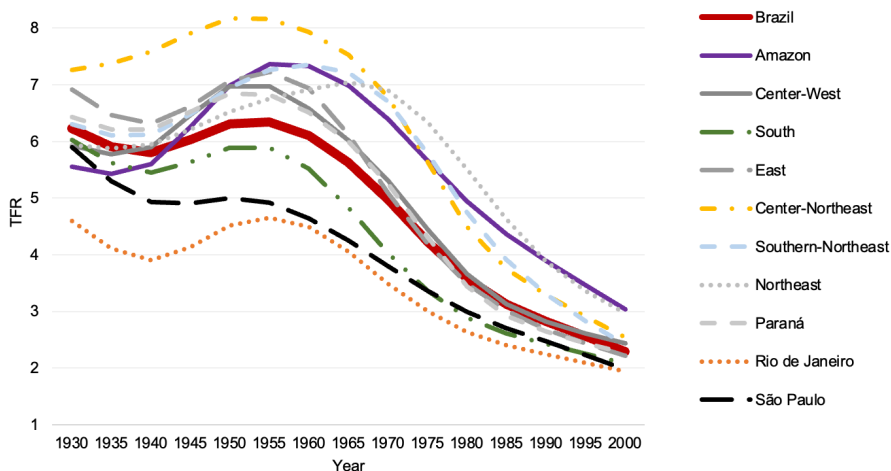
century and the beginning of the 20th century (Figure 1a). The decrease may have started in the 1930s, especially in Rio de Janeiro, in São Paulo, and in the South, which concentrated almost 60 % of the Brazilian population then. On the other hand, the fertility would have been constant or even increased in the other Macroregions: North, Northeast, and Center-West. According to Quaresma (2019), fertility decline is concentrated in the urban areas of the pioneer regions.

Figure 1a. Sweden, England, Brazil and selected developing countries: Total fertility rate for selected periods.



Source: Quaresma, 2019; Human Fertility Collection, 2019; Wong, & Carvalho, 2006.

Figure 1b. Total period fertility rates, Brazil and Regions, and Sub-regions, 1930-2000.



Source: Quaresma, 2019.

Brazil's fertility appears to have slightly recovered between the mid-1940s and mid-1960s. Again, among the Macroregions, the picture was different. On the one hand, in the Amazon, the Center-Northeast, the Southern-Northeast, and the Northeast, fertility was almost stable until 1940. On the other, fertility was decreasing in the Center-South, especially in Rio de Janeiro and São Paulo (Figure 1b). Apparently, fertility increased nationwide, but not in São Paulo in that period. It should be highlighted that the regions from the North and the Northeast had not started their fertility transition until that period. A similar fertility recovery was also observed in other Latin-American countries such as Mexico and Argentina (Quaresma, 2019; Quaresma et al., 2018; Sacco, & Andreozzi, 2017; Terán, 1990).

That recovery between the mid-1940s and mid-1960s in Brazil may be correlated either to an increase in fecundity, as a consequence of nutrition and health improvement as was the case of Mexico (Terán, 1990), or to a decrease in widowhood at the reproductive ages, due to declining mortality rates in the country as a whole (Rios-Neto, 2000). Other explanations could be a baby boom post-war reaction as the United States and Australia experimented (McDonald, & Belanger, 2016) – though Brazil had no prominent warlike role – and an increase in education along the industrialization processes.

It is important to note that the increase in fertility occurred in regions where fertility control was either weak or nonexistent, apparently. The recovery was not prominent among the other regions, probably due to contraception practices like sterilization and hormonal pills. São Paulo is a good example; 65 % of married women controlled their fertility in the 80s, being that almost 30 % of it refers to sterilization (Berquó, 1987).

The second phase of the fertility transition in Brazil started after the mid-1960s. Since then, fertility has been decreasing faster in all Macroregions even when the process is analyzed in a more aggregated way, as in Table 1. It reached first the South and the Southeast in the mid-1950s and then the other areas. As an example, the TFR decreased from 8.1 to 2.3 in the North between 1970 and 2010, while it has been less accentuated in the Southeast: 4.8 to 1.6, in the same period (Table 1), although we must recognize that the relative change is above two-thirds of the initial TFR in both cases. Only the North is still above the replacement level in 2010 (Carvalho, Quaresma, & Silva, 2018). Consequently, the Brazilian 2010 Census shows a fertility level convergence trend among Macroregions and educational and occupational groups (Sacco, & Borges, 2018).

Table 1. Total fertility rate, Brazil and Regions, 1970-2010

Region	Year				
	1970	1980	1991	2000	2010
Brazil	5.84	4.33	2.87	2.37	1.76
North	8.11	6.43	4.21	3.18	2.31
Northeast	7.21	6.11	3.75	2.69	1.91
Southeast	4.80	3.44	2.35	2.10	1.57
South	5.41	3.62	2.52	2.24	1.65
Midwest	6.40	4.50	2.71	2.27	1.83

Source: *Brazilian Census from 1970 to 2010; the 2010 estimations are from Carvalho, Quaresma, & Silva, 2018.*

The heterogeneity is also observed within regions and is associated with social and economic changes operating since the 60s in Brazil, including infant mortality decline (Muniz, 2009; Potter et al., 2006, 2010; Potter, Schmertmann, & Cavenaghi, 2002).

At the small area level, the fertility transition began among South and Southeast Microregions and municipalities (Potter et al., 2006, 2010; Potter, Schmertmann, & Cavenaghi, 2002), confirming the aggregated level analysis. The works focusing on this analytic level point to the beginning of the process in the 1940s at least (Potter et al., 2006, 2010; Potter, Schmertmann, & Cavenaghi, 2002). The lowest pre-transitional fertility level identified among the small areas was a TFR of between 4 and 5 births per woman, and it corresponded to the South and Southeast Regions (Potter et al., 2006, 2010; Potter, Schmertmann, & Cavenaghi, 2002). The speed of the fertility decline was associated with the social development degree in the region at the beginning of the transition (Potter et al., 2006).

The role of territorial space in the Brazilian fertility transition is worth noting. First, there is a relationship between fertility and space. Nearby places can influence each other through networks, which, in turn, depend on the strength of their cultural ties. Therefore, the factors behind the fertility transition should be analyzed together with structural and ideological changes (Muniz, 2009). Thus, although fertility had started falling in the more developed regions of Brazil, as mentioned before, it occurred first in the closest and most homogenous places spreading out then through the country. Second, although Brazil has an enormous territorial extension, the absolute predominance of one language influenced the timing and pace of the fertility transition. Third, despite socioeconomic inequalities (as

the HDI shows in Figure 1A), Brazil's sharing of relatively similar family values, religiosity, and aspirational consumption patterns prevailed throughout the national territory thanks to an impressive penetration of mass media (Faria, & Potter, 2002). Fourth, as said, the onset of fertility transition and its time trend are associated with factors related to social and economic changes, albeit ideational changes were key to it (Potter, Schmertmann, & Cavenaghi, 2002; Schmertmann, Potter, & Cavenaghi, 2008). Fifth, after the onset of the Brazilian fertility decline, its pace was associated with social development (Potter, Schmertmann, & Cavenaghi, 2002), similar to what happened in Europe (Bongaarts, & Watkins, 1996).

A substantial part of the spatial-temporal pattern in Brazilian fertility change may be correlated to similar spatial patterns in economic development, particularly between distant municipalities. In another way, the answer to the correlation between space and Brazilian fertility may be attributed to diffusion. If it has a play in the transition, its role is probably not limited to defining the onset of fertility decline but to determining part of it (Schmertmann, Potter & Cavenaghi, 2008).

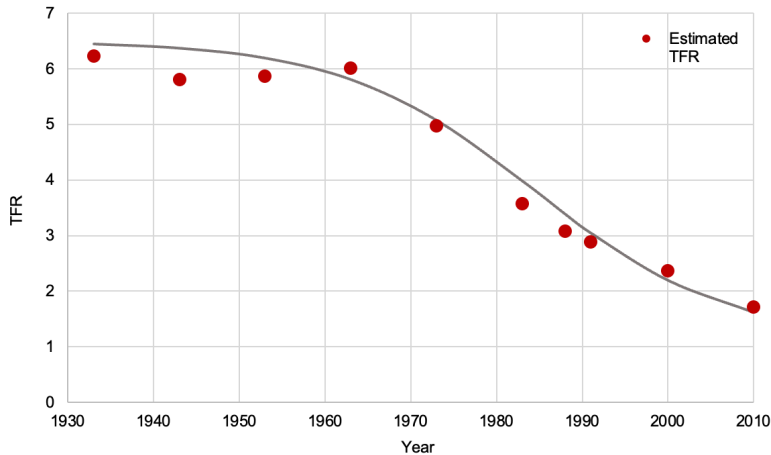
Data and Methodology

Basic data inputs to measure heterogeneity are the total fertility rates from the current 5,565 Brazilian municipalities for 1991, 2000, and 2010 provided by the Human Development Atlas (HDA), which uses census data (PNUD, IPEA, & FJP, 2013).

The HDA applied two criteria for estimating the TFRs. For municipalities with more than 30,000 inhabitants, the TFRs were calculated by applying the Brass P/F ratio (Brass, & Coale, 1968). An indirect standardization was carried out for municipalities with equal or less than 30,000 inhabitants. The municipality's fertility pattern was assumed to be equal to the Microregion standard. The level, i.e., the TFR, was adjusted considering the parity of women aged 20-24 and 25-29 from both, the municipality and Microregion.

In this paper, we estimate the onset of the fertility transition for each municipality mentioned in the previous paragraph using the parameters of a Brazilian logistic curve (see Figure 2). We used a logistic approach because of the visible logistic trend of the Brazilian fertility (see Figure 1a). The procedure's steps are described below.

Figure 2. Total fertility rate estimated and logistic adjustment, Brazil, 1930-2010.



Source: Carvalho, Quaresma, & Silva, 2018; Frias, & Carvalho, 1992; Horta, Carvalho, & Frias, 2000.

We assumed that the Brazilian trend has a maximum and a minimum point and that the TFR between these two points has a logistic pattern (Chackiel, 1984),

$$f(F_t) = \frac{1}{1 + e^{a+bt}}, \quad (1)$$

where (1) describes the $f(x)$ variation in time between 0 and 1. So, the transition would pass from a high-medium level to a low level, remaining only to identify the speed of these changes. To describe those changes, the logistic function was estimated by time, although it is possible to incorporate other variables for a better understanding of fertility, such as education.

Knowing that the TFR will reach, in the limit, *a theoretical minimum future level* (F_{post}) and that the transition into this level implies a reduction ($F_{pret} - F_{post}$) from *a theoretical maximum past level*, we can rewrite (1) as follows:

$$F_t = F_{post} + \frac{F_{pret} - F_{post}}{1 + e^{a+bt}} \quad (2)$$

TFR estimates from different works (Carvalho, Quaresma, & Silva, 2018; Frias, & Oliveira, 1991; Horta, Carvalho, & Frias, 2000) were used to estimate the logistic curve parameters in (2). They refer to 10 TFR values between 1930 and 2010. The theoretical minimum future level was 1.1, that is the TFR the most

educated women TFR had in 2010¹ (Berquó, & Cavenaghi, 2014). Linearizing (2), we have as follows:

$$F_t - F_{post} = \frac{F_{pret} - F_{post}}{1 + e^{a+bt}}$$

$$1 + e^{a+bt} = \frac{F_{pret} - F_{post}}{F_t - F_{post}}$$

$$e^{a+bt} = \frac{F_{pret} - F_{post}}{F_t - F_{post}} - 1$$

$$e^{a+bt} = \frac{F_{pret} - F_{post}}{F_t - F_{post}} - \frac{F_t - F_{post}}{F_t - F_{post}}$$

$$e^{a+bt} = \frac{F_{pret} - F_t}{F_t - F_{post}}$$

$$a + bt = \ln \left(\frac{F_{pret} - F_t}{F_t - F_{post}} \right) \quad (3)$$

Parameters a and b are calculated through equation (3) and applying Ordinary Least Square method, thus allowing to determine all the TFR for every year throughout the transitional period. Therefore, we assumed that all the Brazilian municipalities would pass through the transition, on average, at the national pace but at different times.

The Brazilian pre-transitional phase includes an increase in fertility, so the variable “time” does not necessarily represent a unique moment; in fact, the pick can occur either in a pre-transitional or later, that is, in the second phase or acceleration phase, with a level below the peak. This peculiar pick is not observed in figures 2 and 3 because the exposed functions smooth them so that the highest level is reached at the beginning of the 20th century; it is the result of a mathematical adjustment of the national function. Fluctuations on a local scale hinder the possibility of having one unique

1 The upper asymptote's value was determined iteratively, achieving a pre-transitional TFR of 6.5 children per woman. It is important to say that the regional differences observed in Brazil suffer Simpson's paradox (composition effect), with the most populous regions having a stronger influence on the national average.

function that expresses the systematic trend of a logistic type. However, an assumption underlying the use of the method is the stationarity of first and second order in the two parameters of the logistic regression at the municipal level. I.e., even if there are local fluctuations, they are assumed to be deviations and fluctuations around the average evolution described by the logistic curve. As discussed before, the assumption is false since the country's fertility transition has been heterogeneous. However, the assumption allows us to use the national parameters a and b for each municipality and identify the corresponding year to which the municipal TFR was in the Brazilian transition.

The increase in fertility observed in Figure 2 and widely discussed in the literature (Frias, & Oliveira, 1991; Quaresma et al., 2019) would not invalidate the proposed exercise, given that the variation is not accentuated. However, if the transition had been fast, the modeling would have had to be adjusted to that reality, particularly regarding the definition of the asymptotes.

The same equation and parameters were applied to the municipalities in 1991, 2000, and 2010. Therefore, we rewrote (3).

$$a_{br} + b_{br}t_{br} = \ln\left(\frac{F_{pret} - F_{br,t}}{F_{br,t} - F_{post}}\right) \quad (4)$$

If each Brazilian municipality is in a different position in time, but if the transition is the same for all of them, you may rewrite (4) as follows,

$$a_{br} + b_{br}t_{br} = \ln\left(\frac{F_{pret} - F_{i,t}}{F_{br,t} - F_{post}}\right)$$

$$t_{br} = \frac{1}{b_{br}} \left[\ln\left(\frac{F_{pret} - F_{i,t}}{F_{br,t} - F_{post}}\right) - a_{br} \right], \quad (5)$$

where $F_{i,t}$ is the municipal TFR i at time t and t_{br} is the time in which municipality i is in the national trend. The time location using (5) makes it possible to classify Brazilian municipalities in each census year (1991, 2000, and 2010) in four categories: pre-transition (before the onset of fertility decline); transition in acceleration (until the moment where the national curve inflects); transition in deceleration (between national inflection curve and the replacement level); and below the replacement level (TFR below 2.1). So, i.e., if the TFR of a municipality A is 5, the year t calculated using parameters a and b is 1974.

Three final points should be highlighted in this section. First, the main assumption is that we will see a convergence of the fertility trend, being the national transition as the average pattern. Second, it is possible to apply the same idea to other countries or other regional classifications where the data is available. In addition, it is worth noting that the classification made here goes from 1910 to 2030; past and future TFR were extrapolated using the logistic curve parameters.

Although we know the pace of the fertility transition is heterogeneous in Brazil (Potter et al., 2006, 2010), this assumption allows us to understand how apart or not each municipality is from the Brazilian trend through space and time. Although this proposal breaks the convergence assumption, our approach allows us to evaluate a counterfactual event and project, for each municipality, the window of opportunity lost (or not) based on the actual trend observed in Brazil. As will be discussed, there are still laggard municipalities in the fertility transition process in 2010, indicating that there is still a field to discuss social policies at the local level.

Finally, our procedure allows us to measure the heterogeneity of fertility transition by classifying each municipality according to its own fertility transition stages.

Results

We present the results that explain the transition process, firstly through descriptive statistics and secondly by the location time of each municipality in the Brazilian fertility transition trend (Table 2). Mean and median decreased by more than 40 % over the two decades at about the same speed each decade. Approximately 50 % of the municipalities were already below or very close to the replacement level by 2010 (2.13). Concomitant with the fertility decline, the difference between municipalities has decreased, and so has the variance in the last two decades: 1.293 to 0.708.

Table 2. Mean, median, variance, coefficient of variation and beta convergence of the municipal TFRs, Brazil, 1991-2010.

Year	Mean	Median	Variance	Coefficient of variation	Beta Convergence*
1991	3.73	3.40	1.293	0.334	-0,4984
2000	2.87	2.68	0.798	0.333	-0,2159
2010	2.19	2.13	0.708	0.395	-

* Values referred to the period between the year indicated and the next.
Source: PNUD, IPEA, & FJP, 2013.

The reduction in the variance observed in Table 2 could only explicitly indicate a decrease in data variability if the mean TFR was constant. The constant coefficient of variation between 1991 and 2000 and the increase in 2010 implies that the dispersion of municipal TFR in relation to the mean national increased in the last decade as observed.

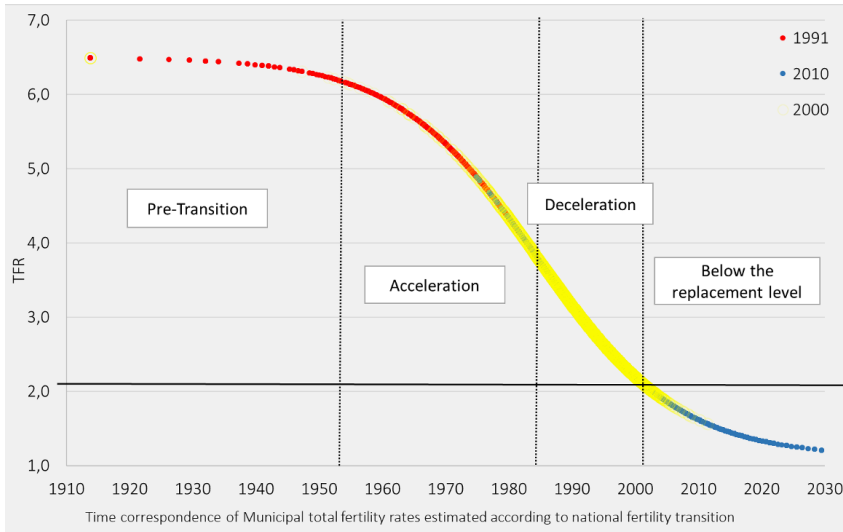
Convergence based on variability (known as sigma-convergence) is not identified, such dispersion can be explained by the moment of transition in each municipality, including the speed and level of fertility. Thus, when evaluating the beta-convergence², it is noticed that the municipalities with the highest TFR in 1991 also showed a sharper decline in the indicator between 1991 and 2000 (negative beta-convergence coefficient). The same occurred between 2000 and 2010, with less intensity. This scenario means that the highest TFR levels showed a greater drop during the analyzed periods, reaching or decreasing the distance in relation to the most advanced municipalities in the fertility transition. The increase in the beta-convergence value in the period can be explained by the higher dispersion observed by the coefficient of variation (sigma-convergence), a possible result of a deceleration of the transition in the period. Figure 3 shows municipalities' TFR for 1991-2010, according to the year where the rates should be if they were following the Brazilian national pattern of the fertility transition. The onset of fertility transition would have started by the early 60s when TFR crossed the 6 children per woman (cpw) mark. Part of the municipalities was either at the transitional stage or sharply declining in 1991. Following the transition, almost all municipalities were immersed in a decisive decline in 2000. By 2010, almost half of the municipalities reached TFR below the replacement level.

An overview of the regional differentials in the country is shown in Figure 4. Municipal TFRs are classified according to the equivalent Brazilian TFR transition and its corresponding year in each census year (1991, 2000, and 2010). This means these municipalities' TFRs in 1991 reflect the Brazilian level at the beginning of the 20th century, showing the differential fertility transition moment throughout the country. There are municipalities with TFR equal to that estimated for Brazil even since the 1910s – mainly the North region and some municipalities from the Northeast – in 1991 (first map on

2 The beta-convergence indicator is estimated by linear regression between the difference between the TFR at the beginning of the period and the next one. Thus, negative values for the slope coefficient (beta-convergence coefficient) indicate that units that have high values are catching up with those with lower values, while positive values indicate greater divergence. Values close to zero indicate regional stability of the indicator under analysis (Janssen et al., 2016).

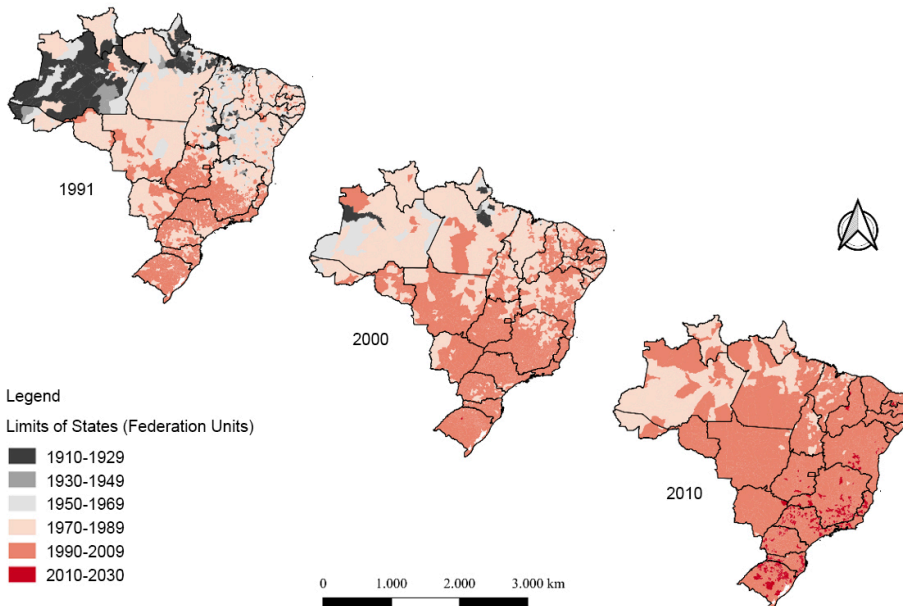
the left). Simultaneously, many municipalities in 1991 had a TFR similar to that registered for Brazil between 1990 and 2000, most of them in the South and Southeast.

Figure 3. Municipal total fertility rates estimated in census year according to the correspondent estimated year, Brazilian municipalities, 1991-2010.



Source: Row data from PNUD, IPEA, & FJP, 2013.

Figure 4. Municipal moments of fertility transition classified according to the 1910-2030 Brazilian trend, 1991-2010.



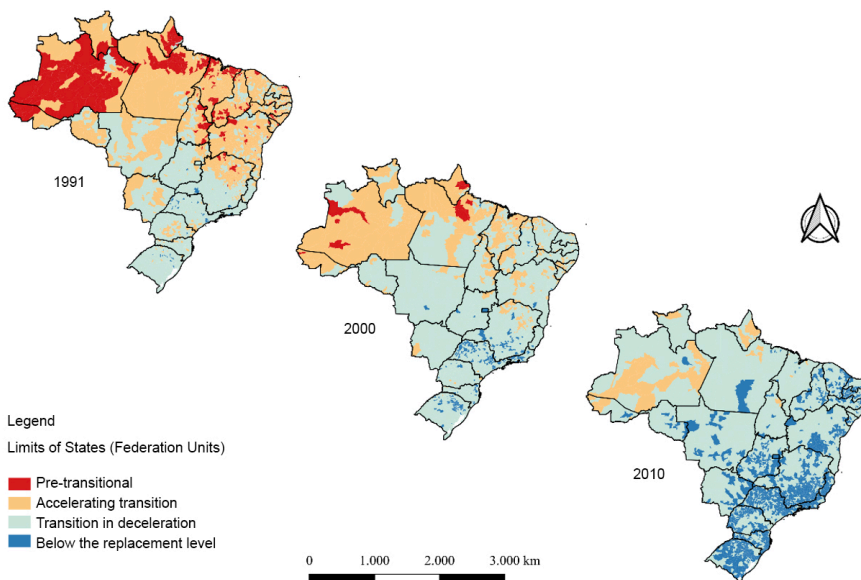
Source: PNUD, IPEA, & FJP, 2013.

The entire South and Southeast region were practically in the rhythm of the national average in 2000, meaning that all their municipal TFRs were below 5 cpw and, often, below 3. Despite the intra-regional differences, the Northeast presented a similar pattern to the South and Southeast, converging with the national average.

In 2010, the entire South and Southeast were in the national average transition process or ahead of Brazilian time. Furthermore, the transition of the municipalities from North and Northeast accelerated in 2010, which reduced the disparity among the Regions, pointing to a process of convergence of the fertility level in the country.

Figure 5 translates municipal moments of fertility transition according to the Brazilian trend plotted in the previous figure to the equivalent Brazilian Transitional Phases to identify each municipality's transition moment in 1991, 2000, and 2010. Map for 1991 reinforces that, while nearly all municipalities in the South had years equivalent to the period of deceleration of the fertility transition in Brazil, an important number of municipalities in the North, particularly those located in frontier areas, were in the pre-transitional fertility stage. Twenty years later, in 2010, municipalities in the North and Northeast already had fertility levels similar to those in the South and Southeast, the country's most developed regions. There is a clear convergence pattern towards the below the replacement level.

Figure 5. Municipalities' moments classified according to Brazilian transitional stages at the corresponding time, 1991-2010.



Source: PNUD, IPEA, & FJP, 2013.

Discussion

This paper analyses the heterogeneity of the Brazilian fertility transition throughout their 5,565 municipalities for three points in time: 1991, 2000, and 2010. Although this disaggregation level has been considered (Muniz, 2009; Potter et al., 2006, 2010; Potter, Schmertmann, & Cavenaghi, 2002; Schmertmann, Potter, & Cavenaghi, 2008), they focus on the singularity of the process in each municipality to approach then the heterogeneity.

The central assumption of this paper is that the national Brazilian fertility transition defines the pathway that every municipality follows. The rationality is that the country, throughout its immense territory, has a population that, despite the dominant economic inequality and regional heterogeneity, shares relatively similar family values, religiosity, and aspirational consumption patterns, managed to prevail throughout the national territory thanks to, mainly, an impressive penetration of mass media (Faria, & Potter, 2002).

National literature shows, in addition, that onset, pace, and time are different among these municipalities. Our assumption, however, allows us to discuss possible implications because of these heterogeneity paths. By considering the national pathway of the fertility transition and the actual trend that municipalities have followed with their different timing, we noticed a municipal convergence trend towards the replacement level.

The convergence process appears when the fertility transition moment from each municipality is compared to the national transition. North and Northeast municipalities had Brazilian pre-transitional fertility over the 90s by 2010, however, this profile disappears and most of the municipalities regardless of their location, have a TFR around or below replacement level. It is the consequence of the different manifested decline that each municipality experienced, already noticed in other studies (Muniz, 2009; Potter et al., 2006, 2010; Potter, Schmertmann, & Cavenaghi, 2002; Schmertmann, Potter, & Cavenaghi, 2008).

In sum, TFRs at the municipal level did decrease with different and higher speeds than the average country. The regional differences highlight the heterogeneity of fertility transition in Brazil. It is plausible to assume that municipalities will follow the national trend in the short run, particularly those from the North and Northeast. If this hypothesis fits, municipalities that by 2010 are either at the accelerated or decelerated stages (See map for 2010 in Figure 5) may take, at the most, 15-20 years to reach the lowest levels forecasted for Brazil (See logistic curve in Figure 3). Our results have shown,

however, that, due to the convergence trend, the current municipalities with the highest fertility levels in 2010 may reach the minimum levels projected in much less time.

Historical trends of fertility decline in more developed countries (shown in Figure 1a) have been slower and with probably, less internal heterogeneity than the one detected in the Brazilian case, allowing them to gradually reach reasonable social organization and well fare. Nevertheless, the detected trend towards homogeneity by means of heterogeneous fertility declines with such uncommon speed is a challenge for the design of any social policies and an important forewarning for decision-makers in large and small areas.

Certainly, such a demographic change, particularly for small areas – and more than 75 % of the Brazilian municipalities are so – implies unusual changes in the age structure as fairly demonstrated by several studies in and outside Brazil. Social demands, consequently, will need to urgently be re-evaluated by integrating this heterogeneity, particularly those age-related services such as maternal and infant care health, education, employment, social security, elder population health care, and so on.

Finally, a possible limitation implicit in these results is the use of secondary data at the municipal level; we believe, notwithstanding, that sources and methods used to produce them are enough to validate them. Also, it is a commitment in our research agenda to replicate this proposal once more up-to-date data are available.

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Annex

Figure 1A. Municipal Human Development Index 2010, Brazil.

