Multidimensional convergence and the role of government: an analysis for the Brazilian states

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Abstract: This paper seeks to bring the scope of social convergence (σ and β) between the states for the period from 1990 to 2010 with the use of a panel data model. In addition, it seeks to verify the role of government on convergence. Considering that much of the literature on economic growth typically measures growth using Gross Domestic Product (GDP), we innovate by aggregating the analysis of the convergence of welfare. Empirical evidence shows that economic convergence is followed by social convergence, with a peculiar behavior of non-homicide rate and fecundity variables. In addition, government variables have a modest impact on economic and social growth and, in some cases, contribute to the reduction of the speed of convergence. In addition, government variables have a modest impact on economic growth and social welfare indicators.

Key words: Convergence; Inequality; Welfare; Government, Brazil.

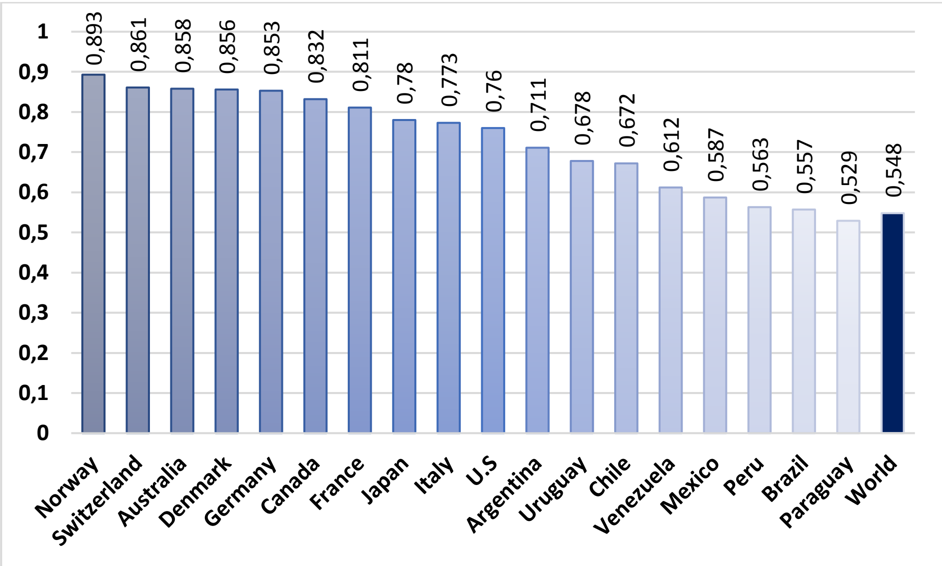
JEL: C23, O47, R11.

1. Introduction

Much has been discussed about inequality and economic growth between regions. Conventional literature, which is based on a vast number of empirical and theoretical works, suggests that economic growth reduces poverty. Many authors investigate the differences in growth between countries and many others seek to understand the inequalities between regions within a country, since the economic environment is assumed to be more homogeneous. It is in this last chain that the present research is established, aiming at the attempt to understand the growth patterns of the Brazilian states.

Recent data show that inequality regarding income, wealth and opportunity continues to grow in the world. Data from the United Nations Development Program (UNDP, 2015) report for the year 2014 show that about 80% of the world's population holds only 6% of the world's wealth. What is new is the reduction in the number of people living in extreme poverty around the world, from 1.9 billion to 836 million between 1990 and 2014. In addition, according to the report, Brazil obtained an Inequality-adjusted Human Development Index (IHDI) of 0.55 in 2014, below the average of the countries of Latin America and the Caribbean, which was 0.57 (Figure 1). It is important to note that, in a recent study, King and Ramlogan-Dobson (2015) find evidence that growth in almost all Latin American economies is actually systematically related to that of the US, but the relative income level to which some have converged is rather low.

Figure 1 - Inequality-adjusted Human Development Index (IHDI) - 2015



The Brazilian reality is still of concentration of economic activity, but with down trend. The Southeast region, the second smallest territorial region of the country, has more than 44% of the total population and is responsible for more than half of the national GDP. However, a comparison of the years of 1990 and 2010 shows that there was a reduction of the share of the Southeast region in the GDP, from 60.7% to 55.3%, in favor of other regions, such as the Midwest, which increased its share from 7.6% to 9.2%. The North region performed less, going from 3.7% to 4.9% in the period. In this sense, there are indications of a process of regional deconcentration.

It is pertinent to mention at this point that an important aspect in the study of economic growth and income inequality between regions is the existence or not of the convergence process. The notion of convergence refers to the idea of reducing income inequality between regions. It refers to a process in which economies exhibit increasing similarities in performance patterns over time. It should also be noted that, in view of the productivity of capital, the idea of convergence signals that the poorer economies, that is, more distant from their stationary states, are growing faster than the richer economies. Thus, according to these assumptions, it is clear that there is a process of convergence between the incomes of certain regions, leading to a convergence of welfare and improvement in the living standards of the poorest regions. However, poverty rates and living standards may not be in line with GDP growth.

It is in this context that the present research finds stimulus, bringing empirical evidences about the convergence of well-being, seeking to answer the following questions - does the convergence of well-being occur simultaneously to the convergence of income? What is the role of government in economic and social convergence? The purpose is to provide a multidimensional picture of convergence in order to verify the role of government in economic convergence and well-being among the regions of the country. His contribution to literature is given in assessing social convergence and government influence in this process. This information can be valuable for the scope of public policies. Studies of this nature have not yet been performed for the Brazilian context.

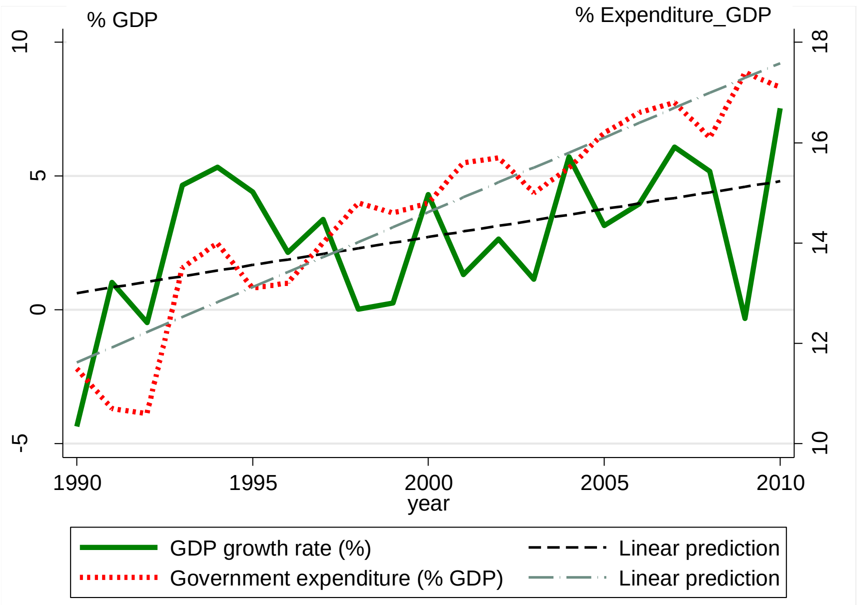
In the international context, some studies analyze the relationship between social indicators and convergence, most of which are global, such as the studies by Neumayer (2003), Becker, Philipson and Soares (2005), Dorius (2008) and Rodríguez-Pose and Tselios (2015). The results differ depending on the set of countries analyzed, the time period and the selection of indicators. Other few studies address the intraregional issue, that is, between regions within the same country. Among them, it should be highlighted that of Royuela and García (2015) and Marchant and Ortega (2006), which serve as motivation for this research.

There is good reason to suppose that government size can interfere with economic growth and convergence between regions. If, on the one hand, there is research that considers the role of beneficial government, especially for less developed economies, on the other hand, there are studies that argue that the minimal state presence is the best context for any economy.

The Figure 2 shows that in the period under review, government size is increasing more than the rate of economic growth in Brazil. The growth of the economy appears along the left vertical axis, as the rate of change of real GDP. Government size is measured along the right vertical axis, by the federal government's primary expenditure as a proportion of GDP. Primary expenditure, also known as non-financial expense, corresponds to the set of expenses that make it possible to offer public services to society, less financial expenses. By plotting a trend line by simple linear regression, we find that the slope coefficient of GDP growth is 0.20 while that of primary expenditure is 0.28, which corroborates the more pronounced growth of expenditure.

Barro (1990) analyzes the first efforts to relate economic growth to the size of government, finding that most studies (internationally) find a negative correlation between these two variables. He points out that an increase in government size in relation to the economy is beneficial to growth when the government is too small and has the opposite effect when the government is large. Being basically an input in the production process, there is an optimal relative size that the government must assume.

Figure 2 - Economic Growth versus Size of Government



Notes: Because of the National Treasury to make these data available only from 1997 onwards, we used data from IBRE / FGV.

In general, the results show a relationship between economic and social convergence for the period analyzed, with the exception of the variable related to crime. In the analysis of σ-convergence, the variables show a decreasing trajectory in their dispersion, indicating that the states are, on average, more similar in these questions. In the β-convergence analysis, the economic and social variables present a high convergence speed considering the specific effects of the states.

The empirical results show that the government has a modest and, in some cases, little beneficial impact on economic growth and convergence. Considering the model with fixed effects, the results show statistical significance for three variables - GDP per capita, literacy. The budget surplus has a positive impact on GDP per capita, contributing to economic growth. The variable FPE (State Participation Fund) has a negative impact on economic growth. Expenses and revenues positively influence literacy, at levels of 0.7 and 0.8%. In most cases, the speed of convergence decreases or does not change when government variables are included, which may indicate an ineffective fiscal policy role.

Besides this introduction, this research is structured in 4 other sections. Section 2 presents the basic concepts of convergence together with the empirical strategy used. Section 3 presents the results obtained for the tests of σ-convergence and conditional β-convergence. Finally, in section 4 the final considerations of this research are reported.

2. Theoretical background

2.1 Convergence Concepts

From the earliest studies of regional inequalities, such as those of Kuznets (1955) and Williamson (1965), convergence between territories has always attracted the attention of researchers in the area. In these initial studies, an index similar to the standard deviation was used as a measure of income dispersion, known today as σ-convergence. This then became the simplest concept of convergence and, according to Quah (1993), can be understood as the continuous dynamics of reducing the differences between regional incomes, which leads to less dispersion and less inequality between economies. The literal concept of σ-convergence was introduced by Barro (1991).

In order to verify the dispersion behavior among the incomes, two measures are routinely used in the literature - Theil index and coefficient of variation. Traditional methods include the study of the trajectory of these indices over time and a linear regression of the income variation against time can also be used to check if there is any tendency to fall in the dispersion. In this research, we opted for the observation of the indicators throughout the study period.

Nevertheless, the development of theories of economic growth to understand the patterns between countries has aroused a lot of interest and in the studies of Abramovitz (1986) and Baumol (1986) the second concept, the one of β-convergence, has arisen. These pioneering studies served as a stimulus for many other works in the area, particularly those of Barro and Sala-i-Martin (1991)[1]. These surveys derive from the neoclassical growth model of Solow (1956), and imply that the economic growth of the regions depends on their initial income level. A positive result for this process indicates that poor countries or regions will grow more than the richer regions.

It is also emphasized that β-convergence is discussed in the literature under two main approaches, namely, absolute and conditional[2]. Absolute β-convergence considers that the backward economies in relation to economic growth tend to grow at rates higher than the rich economies and that, therefore, at some point these incomes would equal. The conditional form of convergence only occurs when the regions have identical structural characteristics. Thus, this definition predicts that regions may converge to different steady states, and poor economies will not necessarily reach the per capita income level of the richer ones. Therefore, the rate of growth of each economy will be all the greater the farther it is from its own steady state.

As Quah (1993) points out, β-convergence is a necessary condition, but not sufficient for the existence of σ-convergence. For example, if poorer economies grow faster than richer ones to the point of overcoming them, there may be an increase in the dispersion of per capita income between regions, a result favorable to β-convergence, but not to σ-convergence. To achieve better results, it is interesting to carry out both investigations.

2.2 Neoclassical convergence model

For the investigation of economic and social convergence, the neoclassical approach of β-convergence of Barro (1991) and Barro and Sala-i-Martin (1991, 1992), as used by Rodríguez-Pose and Tselios (2015) is used. In addition to the traditional analysis of the per capita income growth rate, the model addresses the growth rate of regional welfare variables between two points in time, t and t + T, as follows:

$$\left(\frac{1}{T}\right)\ln\left(\frac{y_{i,t+T}}{y_{i,t}}\right) = \alpha - \frac{(1-e^{-\beta \mathrm{T}})}{\mathrm{T}}\ln(y_{i,t}) + \varepsilon_t \quad (1)$$

In that y denotes each variable under analysis in this research (economic and social). According to Barro and Sala-i-Martin (1991) and Baumol (1986), it is possible to infer if there

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[1] Derived from the growth model of Solow (1956), Swan (1956), Cass (1965) and Koopmans (1965).

[2] The definitions used here refer to Barro and Sala-i-Martin (1992).

is convergence from the estimated coefficient for initial variable y, as in the equation $\gamma = -\frac{1-e^{-\beta T}}{T}$ T, where β is the velocity of convergence. Using algebraic manipulation, one can calculate the convergence velocity directly by the following equation: $\beta = -\frac{ln(1+\gamma T)}{T}$. In addition, the speed of convergence can be better interpreted through the calculation of the half-life, that is, of the time that the economies take to reach half the distance to their steady state, being defined as *half-life* = $\frac{ln\,2}{\beta}$.

The most basic analysis is the use of OLS (Ordinary Least Squares) estimation. The basic assumption is that the economies considered in this model are homogeneous. Mankiw, Romer, and Weil (1992) estimate an increased Solow model in which they express growth as a function of the initial level of income and a set of other variables that represent the steady state of the different economies. This model seems plausible since, in general, countries and / or regions have different characteristics. By inserting the vector of variables (X) as a proxy for the different stationary states, equation (3) becomes:

$$\left(\frac{1}{T}\right) ln\left(\frac{y_{i,t+T}}{y_{i,t}}\right) = \alpha - \gamma \ln\left(y_{i,t}\right) + \vartheta X_{i,t} + \varepsilon_t \qquad (2)$$

In addition, it is important to note that the use of cross-section regression may not be the most appropriate form, since it assumes that all regions have the same production function. However, it is known that there are specific effects of each region that are not considered in the regression and may be biasing the estimated coefficient due to the existence of omitted variables. Cross-section regression would only be consistent if the individual effects were not correlated with the other explanatory variables, which does not appear to be valid for growth regressions. It is emphasized that with the use of the panel data method with fixed effect, it is allowed that there are differences in the aggregate production function between the regions. The equation with panel data for the convergence model can be expressed as follows:

$$\left(\frac{1}{T}\right) ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha - \gamma \ln\left(y_{i,t-1}\right) + \vartheta X_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \qquad (3)$$

In which i indicates the states, t time, μ_i represents the fixed effect by state and τ_t the effect of time. The variable Y will be per capita income, as well as the other social variables considered in this research. Therefore, a regression is estimated for each variable in question.

It should be noted that, in a second moment of the analysis, some explanatory variables were included.

2.3 Description of the database

Considering the proposal of the present research, the variables considered seek to portray the economic and social scope of the Brazilian states. The dataset used here was constructed for the 26 states plus the Federal District and covers the period from 1990 to 2010, taken in triennial averages, in order not to capture the short-term growth and obtain greater stability in the estimates. The main databases used are the Brazilian Institute of Geography and Statistics (IBGE), the Institute of Applied Economic Research (IPEADATA) and the Department of Informatics of the single health system (DATASUS) [3]. The homicide rate was obtained from data from the Atlas of Violence, made available by IPEA[4]. Table 1 shows the variables and descriptive statistics.

Through the selection of variables one seeks to arrive as close to the standards of life and well-being of the population. This selection includes two economic variables (per capita GDP and per capita household income), two related to health (life expectancy at birth and child survival rate), two that refer to education (literacy rate and years of study), one (non-homicide rate) and, finally, one related to demography (fertility rate). It should be stressed that one of the motivations for choosing such variables is their proximity to the human development index (HDI), ie, education, longevity and income.

Because they represent social welfare indicators, variables need to be considered positively - the larger the better. Thus, the literacy rate was obtained by supplementing the illiteracy rate, in a percentage format (100 - illiteracy rate), representing the percentage of the literate population aged 15 years or older. Likewise, the variables child survival and non-homicide were obtained as a complement to infant mortality and homicide rate.

Regarding the explanatory variables, the following variables referring to government size were selected: total revenue (sum of current revenue and capital income as a proportion of GDP), total expenditure (sum of current expenditure and capital expenditure as a proportion of GDP) , budget result (total revenue minus total expenditure as a proportion of GDP) and FPE (state participation fund as a proportion of GDP). The data were collected in IPEADATA. The

[3] Health information - TABNET. Available in: http://datasus.saude.gov.br/informacoes-de-saude/ tabnet.
[4] Violence Map. Available in: http://www.ipea.gov.br/atlasviolencia/series.

geometric rate of population growth is also added as an independent variable in order to capture possible effects of the demographic change that occurred in the period[5].

[5] Given by the expression: $r = [\sqrt[n]{P_t/P_0} - 1] \times 100$. P_0 is the population in the initial period and P_t population at the end of the period.

Table 1 – Definition of variables and descriptive statistics

		1990				2010			
	Description	**Mean**	**Std. Dev.**	**Min.**	**Máx.**	**Mean**	**Std. Dev.**	**Min.**	**Máx.**
GDP	Per capita Gross Domestic Product*	11.21	8.50	4.13	46.11	16.81	10.42	6.88	58.48
Household income	Average per capita household income - total household income due to the number of residents (R $ 2010)*	593.13	288.69	229.46	1317.2	827.93	311.73	470.11	1894.98
Years of study	Years of study average. people 25 years and over (years)	4.54	1.28	2.55	7.49	6.91	1.05	5.14	9.75
Literacy	Percentage of literate population. Persons aged 15 years or more - supplementary illiteracy rate (%)	77.76	12.15	56.35	91.39	89.74	5.93	78.02	97.27
Fecundity	Fertility rate - number of children by women aged 15 to 49 years	3.18	0.75	2.07	4.65	1.97	0.33	1.60	2.81
Survival	Child Survival - Complementary Infant Mortality Rate (per thousand) **	49.41	20.67	-2.19	73.77	82.73	3.78	74.59	88.82
Life Expectancy	Life expectancy at birth (years)	66.40	3.11	59.95	71.21	72.66	2.25	68	76.01
Non-homicide	Non-homicides - complement the homicide rate (per 100.000 inhabitants) **	76.69	14.44	40.07	95.62	68.65	11.97	33.12	86.82
Explanatory Variables									
Revenue	Current revenue plus capital income - based on GDP (nominal values)	853.51	2055.13	3.07	8444.54	661.14	1418.85	5.65	5732.77
Expenditure	Current expenditure plus capital expenditure - by reason of GDP (nominal values)	728.33	1658.21	3.05	8561.22	534.17	1181.17	4.80	6144.70
Budget	Budget result (revenue - expenditure) - by reason of GDP (nominal values)	-36.51	66.86	-324.4	19.73	24.79	26.23	-8.90	92.22
FPE	State participation fund - by reason of GDP (nominal values)	49.48	66.75	0.32	333.06	55.80	60.77	1.83	201.35
Population	Geometric population growth rate (triennial) ***	1.47	1.36	0.007	4.88	1.21	1.63	-1.68	4.49

Notes: The values were updated according to the broad national consumer price index (IPCA). calculated by IBGE. ** To obtain these variables we used 100 minus the value of the observation (100 - y). so as not to leave very large observations. It should be noted that the initial year of the non-homicide variable is 1996.
*** The figures presented for the geometric growth rate refer to the beginning of the period (1990-1992) and the end of the period (2008-2010).

3. Results

3.1 σ-convergence

The Brazilian regions have different characteristics, which make them attractive for studies on inequalities. One factor that can contribute to the disparities is the vast territorial extension of the country. With an area of 8,514,876 km², Brazil is the fifth largest on the planet, behind only Russia, Canada, the United States and China.

In the analysis of σ-convergence it will be possible to verify the dispersion trajectory of the social and economic variables between the states between 1990 and 2010, amid the political and economic transformations and instabilities that occurred in this period. A favorable result for this form of convergence indicates that the states were closer in social and / or economic terms. Tables 2 and 3 show the indicators for σ-convergence analysis. The coefficient of variation (CV) presented is the standard deviation based on the mean of the variables:

$$CV = (1/\bar{Y})\sqrt{\sum_{i=1} \frac{(Y_i - \bar{Y})^2}{(n-1)}} \quad (4)$$

In that Y_i is observed variable for state i, $\bar{Y}$ is the state mean variable and n is the number of states. The standard deviation is also used in the literature to evaluate the concept of σ-convergence. However, a standard deviation can be considered large or small depending on the order of magnitude of the variable. Therefore, the CV seems to be a better measure, since it is not influenced by the order of magnitude.

The Williamson (1965) weighted coefficient of variation, which takes into account the participation of the population of the state over the population of the country, is also considered in the analysis. This indicator can be defined as:

$$CV_w = \left(\frac{1}{\bar{Y}_{Br}}\right)\sqrt{\sum_{i=1} \frac{P_i}{P_{Br}}(Y_i - \bar{Y}_{Br})^2} \quad (5)$$

Where P_i is the population of state i, $\bar{Y}_{Br}$ is the average variable observed for the country and P_Br is the national population. It should be noted that values of CV and CVw very close to zero indicate equality of said variable between states. Table 2 presents these two indicators for a five-year period of the sample. Through the results, it is observed that the GDP has a reduction in the dispersion over time, when considered the standard CV, and a tendency to increase in the dispersion at the end of the period, when analyzed the weighted CV. In contrast, household income shows an increase in dispersion between the years 2000 and 2005 when the standard CV was analyzed, and the reduction of dispersion throughout the period when considering the weighted CV.

Table 2 – Test for σ-convergence - economic variables

	GDP		***Income***	
Ano	CV	CV_w	CV	CV_w
1990	0.759	0.549	0.487	0.396
1995	0.687	0.504	0.401	0.387
2000	0.677	0.483	0.387	0.359
2005	0.643	0.458	0.404	0.348
2010	0.620	0.462	0.376	0.316

Turning to the analysis of social variables, in Table 3, it can be observed that the variables referring to education present both the standard CV and the CV weighted in the downward trajectory throughout the analysis period. The literacy CV has a drop of more than 50% between 1990 and 2010. The variables referring to health, life expectancy at birth and infant survival rate also have a decreasing trajectory of both standard and weighted coefficients, and the second variable has a more pronounced fall, with a coefficient in 2010 about 10 times lower than in 1990. It is interesting to observe the very low coefficients of these variables in the last year of analysis, indicating a context close to equality between states.

Table 3 - Test for σ-convergence - social variables

	Years of Study		***Literacy***		***Life Expectancy***	
Ano	CV	CV_w	CV	CV_w	CV	CV_w
1990	0.285	0.232	0.158	0.143	0.054	0.060
1995	0.219	0.205	0.123	0.115	0.043	0.041
2000	0.192	0.178	0.100	0.093	0.038	0.035
2005	0.183	0.167	0.090	0.080	0.035	0.032
2010	0.152	0.143	0.068	0.063	0.031	0.028
	Child Survival		***Fecundity***		***Non-homicide***	
Ano	CV	CV_w	CV	CV_w	CV	CV_w
1990	0.418	0.372	0.236	0.216	-	-
1995	0.199	0.191	0.205	0.184	-	-
2000	0.115	0.111	0.204	0.144	0.186	0.219
2005	0.068	0.069	0.190	0.146	0.147	0.146
2010	0.045	0.043	0.170	0.123	0.174	0.166

The demographic variable, fertility rate, shows a decreasing movement during the period of analysis, except between 2000 and 2005, when the weighted coefficient was considered, which increased slightly. It should be noted that the weighted coefficient of variation is lower and shows a larger decrease, indicating that when the national fertility rate and the relationship between the state and national populations are taken into account, the reduction in dispersion is greater.

The fall in birth rates appears to be higher in the initial period, between 1990-1995, and in the final period, between 2005-2010. In general terms, the fertility rate has been declining in Brazil - between 1990 and 2010, the rate went from 2.8 children per woman considered to be of childbearing age (15-49 years), to 1.8 children. Female labor market participation also increased in the period - from 32 per cent in 1991 to 49 per cent in 2010[6] - which is likely to contribute to the decline in the birth rate. Besides that, other motives can be traced to this fertility movement, such as the greater access to information and popularization of contraceptive methods and the option for educational and professional training, which has postponed the option for children.

The non-homicide variable, which refers to social coexistence and the level of national security, shows a dispersion between 2000 and 2005 and an increase in dispersion between 2005 and 2010. In fact, during the period of analysis the average number of homicides increased from in the country. Faced with this behavior, it is not possible to verify a convergence trajectory. Finally, considering the weighted coefficient, one can observe the existence of σ-convergence for all variables, except for the non-homicide variable.

3.2 β-convergence and the role of government

The analysis of the estimated coefficients for β-convergence, the tests were carried out using the Pooled Ordinary Least Square (POLS) model and the fixed effects model (EF), the latter being the main model. It was decided by the model of fixed effects by the theoretical relevance in the context of the regional economy, which was corroborated by the Hausman test (1978), in which the null hypothesis was rejected that the random effects are consistent, except in the case of the non-homicide variables and years of study. Then the Chow test was performed under the null hypothesis of stability of the estimated coefficients. This test indicates preference for the pooled model only for the variable years of study, and the fixed effects are significant for the other variables. It is important to mention that all estimates were made using Stata 12.1 software. Tables 4 and 11 present the estimates, noting that the data are in triennial averages.

[6] IBGE data.

In this paper, we propose the use of the pooled model to approximate an absolute β-convergence analysis, which, in turn, adding specific effects of the states in the fixed effects model, is close to the conditional β-convergence analysis. Assuming this assumption, the results are favorable to the two types of convergence. An interesting way to interpret the conditional model is to consider half-life as the time required for convergence if states have similar characteristics.

First, it is worth mentioning the adjustment of the data to the model, through the R-square. According to Wooldridge (2010), the fixed-effects model is also called the whitin model (within), considering the time variation in each of the cross-sections. Thus, the R-square whitin is considered in the analysis, being the adjustment of greater interest. The results obtained for this statistic point to a good fit for most models.

Turning to the analysis of economic variables, presented in Tables 4 and 5, the first two columns of each table present the models without government control variables. Both the initial per capita GDP and per capita household income obtained negative and significant coefficients at 1% for both models, OLS and EF, which is consistent with the existence of a convergence process. It should be noted that when controlled for specific effects of the states (FE model) the speed of convergence increases, showing that these effects may be important.

As for the education variables presented in Tables 6 and 7, similar to the economic variables, they also have a high convergence rate, which is about 16% when considering the specific effects of the states and, consequently, a half-life of 4 years. It is important to note that the average percentage of literate people increased from 77.6% in 1990 to 88.7% in 2010. Meanwhile, the average number of years of study per person aged 25 and over increased from 4.5 to 6.9 in the period.

The health variables, presented in Tables 8 and 9, show results favorable to convergence. It is worth noting that infant survival has the highest rate of convergence among all variables, about 30% - and a half-life of 2 years. Relating to the results of σ-convergence, a possible explanation can be in the similarity of this variable between states, that is, it has already passed through the convergence process and is very close to its steady state. It should be noted that infant mortality declined sharply in the period, from an average of 50.6 deaths per thousand live births in 1990 to 17.3 deaths in 2010. According to the 2010 demographic census (IBGE), Brazil has already reached acceptable levels for this indicator, although still far from the statistics of countries such as Japan, France and Germany, which have rates of approximately 4 deaths per thousand live births.

Table 4 – β-convergence test – Per Capita GDP – 1990-2010

	Per Capita GDP					
	OLS	**FE**	**FE**	**FE**	**EF**	**FE**
$Ln(Y)_{i,t-1}$	-0.021***	-0.434***	-0.436***	-0.430***	-0.430***	-0.457***
	(0.007)	(0.074)	(0.073)	(0.069)	(0.070)	(0.066)
$Ln(Revenue)_{i,t-1}$			-0.007			
			(0.017)			
$Ln(Expend)_{i,t-1}$				-0.019		
				(0.018)		
$Ln(Result)_{i,t-1}$					0.0005***	
					(0.000)	
$Ln(Fpe)_{i,t-1}$						-0.043**
						(0.020)
$Txpop_{i,t-1}$			-0.004	-0.004	-0.002	-0.005
			(0.003)	(0.003)	(0.003)	(0.003)
Constant	0.264***	4.056***	4.119***	4.129***	4.033***	4.407***
	(0.069)	(0.683)	(0.653)	(0.626)	(0.645)	(0.619)
Velocity of convergence %)	2.03	27.79	27.87	27.61	27.61	28.77
Half-life (years)	34.03	2.49	2.48	2.50	2.50	2.40
Breusch-Pagan	0.54					
	[0.46]					
Wald		3871	4304	4367	3959	2136
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		8.95	8.47	8.64	10.10	9.55
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
AIC	-510.43	-679.47	-677.15	-678.84	-691.27	-688.01
BIC	-488.81	-660.94	-649.36	-651.05	-663.48	-663.31
R^2	0.299	0.664	0.671	0.675	0.699	0.689
Obs.	162	162	162	162	162	162

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.

Table 5 – β-convergence test – Per Capita Income – 1990-2010

	Per Capita Income					
	OLS	**FE**	**FE**	**FE**	**EF**	**FE**
$Ln(Y)_{i,t-1}$	-0.060***	-0.321***	-0.310***	-0.310***	-0.309***	-0.319***
	(0.015)	(0.045)	(0.055)	(0.055)	(0.057)	(0.054)
$Ln(Revenue)_{i,t-1}$			0.014			
			(0.024)			
$Ln(Expend)_{i,t-1}$				0.014		
				(0.024)		
$Ln(Result)_{i,t-1}$					-0.0001	
					(0.000)	
$Ln(Fpe)_{i,t-1}$						-0.027
						(0.030)
$Txpop_{i,t-1}$			-0.009	-0.009	-0.010	-0.009
			(0.010)	(0.010)	(0.010)	(0.010)
Constant	0.467	2.087***	1.953***	1.957***	2.025***	2.171***
	(0.094)	(0.284)	(0.278)	(0.286)	(0.348)	(0.372)
Velocity of Convergence (%)	5.51	22.48	21.91	21.91	21.86	22.38
Half-life (years)	12.56	3.08	3.16	3.16	3.17	3.09
Breusch-Pagan	2.70					
	[0.10]					
Wald		632.67	732.08	693.49	602.47	653.27
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		4.52	2.99	3.02	3.03	2.95
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
AIC	-386.04	-493.03	-494.05	-494.07	-493.95	-491.75
BIC	-364.42	-474.51	-469.35	-469.37	-469.25	-470.05
R^2	0.547	0.714	0.723	0.723	0.722	0.724
Obs.	162	162	162	162	162	162

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.%.

Table 6 – β-convergence test – Literacy – 1990-2010

	Literacy					
	OLS	**FE**	**FE**	**FE**	**EF**	**EF**
Ln(*Y*)$_{i,t-1}$	-0.129***	-0.217***	-0.230***	-0.232***	-0.221***	-0.216***
	(0.009)	(0.036)	(0.035)	(0.034)	(0.036)	(0.035)
Ln(Revenue)$_{i,t-1}$			0.007***			
			(0.002)			
Ln(Expend)$_{i,t-1}$				0.008**		
				(0.003)		
Ln(Result)$_{i,t-1}$					-0.00003	
					(0.000)	
Ln(Fpe)$_{i,t-1}$						0.004*
						(0.002)
Txpop$_{i,t-1}$			0.0005	0.0004	0.0002	0.0004
			(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.598	0.986***	1.001***	1.009***	0.998***	0.966***
	(0.041)	(0.158)	(0.154)	(0.153)	(0.158)	(0.160)
Velocity of convergence %)	10.90	16.71	17.49	17.60	16.95	16.65
Half-life (years)	6.35	4.14	3.96	3.93	4.08	4.16
Breusch-Pagan	22.91					
	[0.00]					
Wald		2948	2945	3067	3351	3339
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		1.97	1.75	1.84	1.75	1.54
		[0.01]	[0.00]	[0.00]	[0.00]	[0.00]
AIC	-1009.87	-1066.08	-1064.6	-1065.9	-1062.7	-1063.4
BIC	-988.26	-1047.55	-1039.9	-1041.2	-1038.2	-1038.7
R^2	0.702	0.563	0.570	0.574	0.566	0.567
Obs.	162	162	162	162	162	162

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.

Table 7 – β-convergence test – Years of Study– 1990-2010

	Years of Study					
	OLS	**FE**	**FE**	**FE**	**EF**	**FE**
Ln(*Y*)$_{i,t-1}$	-0.093***	-0.206***	-0.202***	-0.202***	-0.201***	-207***
	(0.012)	(0.059)	(0.058)	(0.060)	(0.055)	(0.050)
Ln(Revenue)$_{i,t-1}$			0.006			
			(0.019)			
Ln(Expend)$_{i,t-1}$				0.008		
				(0.020)		
Ln(Result)$_{i,t-1}$					0.00001	
					(0.000)	
Ln(Fpe)$_{i,t-1}$						-0.012
						(0.015)
Txpop$_{i,t-1}$			-0.002	-0.002	-0.002	-0.002
			(0.004)	(0.004)	(0.005)	(0.004)
Constant	0.217***	0.384***	0.351***	0.339***	0.381***	0.431
	(0.020)	(0.090)	(0.120)	(0.119)	(0.084)	(0.078)
Velocity of convergence (%)	8.20	16.03	15.79	15.79	15.72	16.10
Half-life (years)	8.45	4.32	4.38	4.38	4.40	4.30
Breusch-Pagan	0.59					
	[0.44]					
Wald		1600	1873	1808	1895	934.24
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		0.98	0.92	0.92	0.92	0.92
		[0.50]	[0.58]	[0.57]	[0.58]	[0.58]
AIC	-636.01	-667.11	-664.45	-664.65	-664.31	-665.00
BIC	-614.39	-648.59	-639.75	-639.95	-639.61	-640.30
R^2	0.288	0.157	0.164	0.165	0.163	0.166
Obs.	162	162	162	162	162	162

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.%.

Table 8 – β-convergence test – Life Expectancy – 1990-2010

	Life Expectancy					
	OLS	**FE**	**FE**	**FE**	**EF**	**FE**
Ln(*Y*)$_{i,t-1}$	-0.065***	-0.207***	-0.225***	-0.226***	-0.211***	-206***
	(0.005)	(0.037)	(0.039)	(0.038)	(0.034)	(0.034)
Ln(Revenue) $_{i,t-1}$			0.002			
			(0.001)			
Ln(Expend) $_{i,t-1}$				0.002		
				(0.001)		
Ln(Result) $_{i,t-1}$					0.00003	
					(0.000)	
Ln(Fpe) $_{i,t-1}$						0.001
						(0.001)
Txpop $_{i,t-1}$			-0.0003**	-0.0002**	-0.0002*	0.0002*
			(0.000)	(0.0001)	(0.000)	(0.000)
Constant	0.290***	0.883***	0.947***	0.954***	0.900***	0.874***
	(0.023)	(0.157)	(0.161)	(0.158)	(0.145)	(0.143)
Velocity of convergence (%)	5.93	16.10	17.19	17.25	16.34	16.03
Half-life (years)	11.67	4.30	4.03	4.01	4.24	4.32
Breusch-Pagan	11.85					
	[0.00]					
Wald		1018	1527	1449	950.20	7270
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		9.24	8.04	8.21	8.56	7.69
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
AIC	-1397.03	-1569.39	-1572.19	-1572.69	-1568.04	-1570.66
BIC	-1375.42	-1550.86	1547.49	-1547.99	-1543.34	-1545.96
R^2	0.502	0.578	0.596	0.597	0.585	0.592
Obs.	162	162	162	162	162	162

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.

Table 9 – β-convergence test – Childhood survival – 1990-2010

	Child survival					
	OLS	**FE**	**FE**	**FE**	**EF**	**FE**
Ln(*Y*)$_{i,t-1}$	-0.484***	-0.563***	-0.573***	-0.573***	-0.560***	-0.562***
	(0.068)	(0.069)	(0.070)	(0.072)	(0.071)	(0.070)
Ln(Revenue) $_{i,t-1}$			0.044*			
			(0.022)			
Ln(Expend) $_{i,t-1}$				0.034		
				(0.023)		
Ln(Result) $_{i,t-1}$					0.0001	
					(0.000)	
Ln(Fpe) $_{i,t-1}$						-0.010
						(0.019)
Txpop $_{i,t-1}$			0.0002	-0.0003	0.0003	-0.0009
			(0.002)	(0.002)	(0.002)	(0.002)
Constant	2.075***	2.378***	2.190***	2.24***	2.37***	2.409***
	(0.276)	(0.274)	(0.202)	(0.220)	(0.279)	(0.285)
Velocity of convergence (%)	29.89	32.97	33.34	33.34	32.86	32.93
Half-life (years)	2.31	2.10	2.07	2.07	2.10	2.10
Breusch-Pagan	629.68					
	[0.00]					
Wald		1004	1524	2086	3030	1970
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		8.69	7.17	6.98	8.24	4.04
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
AIC	-526.81	-692.78	-698.07	-695.05	-689.44	-689.45
BIC	-505.20	-674.25	-673.37	-670.35	-664.74	-664.75
R^2	0.895	0.942	0.945	0.944	0.942	0.942
Obs.	162	162	162	162	162	162

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.

Table 10 – β-convergence test – Fecundity – 1990-2010

	Fecundity					
	OLS	**FE**	**FE**	**FE**	**EF**	**FE**
Ln(Y)$_{i,t-1}$	-0.068***	-0.317***	-0.326***	-0.326***	-0.303***	-0.335***
	(0.011)	(0.060)	(0.060)	(0.055)	(0.058)	(0.066)
Ln(Revenue)$_{i,t-1}$			-0.045***			
			(0.012)			
Ln(Expend)$_{i,t-1}$				-0.047***		
				(0.011)		
Ln(Result)$_{i,t-1}$					0.0003***	
					(0.000)	
Ln(Fpe)$_{i,t-1}$						-0.027**
						(0.011)
Txpop$_{i,t-1}$			0.001	0.001	0.003	0.001
			(0.002)	(0.002)	(0.002)	(0.001)
Constant	0.002***	0.278***	0.518***	0.534***	0.264***	0.380***
	(0.014)	(0.066)	(0.089)	(0.078)	(0.063)	(0.092)
Velocity of convergence (%)	6.18	22.27	22.73	22.73	21.55	23.18
Half-life (years)	11.20	3.11	3.04	3.04	3.21	2.98
Breusch-Pagan	0.77					
	[0.37]					
Wald		164.52	375.20	1114	205.00	164.67
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		2.56	3.00	3.23	2.39	2.51
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
AIC	-678.71	-748.10	-759.45	-764.76	-756.07	-750.17
BIC	-657.10	-729.57	-734.75	-740.06	-731.36	-725.47
R^2	0.260	0.331	0.392	0.411	0.379	0.356
Obs.	162	162	162	162	162	162

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.

Table 11 – β-convergence test –non-homicide – 1996-2010

	Non-homicide					
	OLS	**FE**	**FE**	**FE**	**EF**	**FE**
Ln(Y)$_{i,t-1}$	-0.125**	-0.014	0.051	0.058	0.062	0.070
	(0.048)	(0.0124)	(0.106)	(0.102)	(0.115)	(0.113)
Ln(Revenue)$_{i,t-1}$			-0.130			
			(0.091)			
Ln(Expend)$_{i,t-1}$				-0.126		
				(0.011)		
Ln(Result)$_{i,t-1}$					0.0002	
					(0.000)	
Ln(Fpe)$_{i,t-1}$						-0.067
						(0.088)
Txpop$_{i,t-1}$			0.013	0.014*	0.014*	0.015**
			(0.007)	(0.007)	(0.007)	(0.006)
Constant	0.528**	0.049	0.415	0.363	-0.312	-0.136
	(0.211)	(0.528)	(0.652)	(0.594)	(0.494)	(0.476)
Velocity of convergence (%)	10.61	-	-	-	-	-
Half-life (years)	6.52					
Breusch-Pagan	15.32					
	[0.00]					
Wald		1.80	4876	1293	8596	8509
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Chow		2.09	2.27	2.25	2.11	1.79
		[0.01]	[0.00]	[0.00]	[0.00]	[0.02]
AIC	-240.77	-300.45	-308.66	-307.80	-303.92	-304.77
BIC	-227.36	-289.72	-292.56	-291.71	-287.83	-288.68
R^2	0.134	0.078	0.176	0.170	0.139	0.146
Obs.	108	108	108	108	108	108

Notes: (1) Standard error in parentheses. P-value in brackets. (2) When we find heteroscedasticity, according to the Breusch-Pagan and Wald tests, we use robust standard errors. (3) R2 within is considered in the EF model. (*) significant at 10%. (**) significant at 5%. (***) significant at 1%.

The fertility rate also shows convergence, with velocity increasing from 6% to 22% when specific effects of each state are added (Table 10). The analysis of this variable is in contrast to the other variables, since it is the poorest states with the highest fertility rates. The convergence result of this variable may be more plausible when considering the sharp fall in fertility in the poorest regions, not the growth in the richest regions - the North and Northeast regions went from a rate of 3.9 and 3.4 in 1990 to 2.3 and 1.9 children per woman of childbearing age in 2010, respectively. However, it should be noted that the fall in fertility occurred in all income strata, from the poorest to the richest.

The non-homicide variable presented statistical significance only for the pooled model (Table 11). It is interesting to note that the number of homicides per 100,000 inhabitants increased from 23 to 31.3, on average, in the country between 1996 and 2010. The Southeast Region showed inflection in its rates for consecutive years (mainly Rio de Janeiro), which made the Northeast the most violent region in the country since 2006. In the Southeast the number of homicides increased from 34 in 1996 to 23 in 2010 per 100 thousand inhabitants. In the Northeast region, the rate from 18 homicides per 100,000 inhabitants has increased to 41. Thus, this scenario is not favorable to the extent to which the convergence process occurs at the expense of increased violence in certain regions.

In the scenario established with selected social and economic variables, the empirical evidence shows that economic convergence is accompanied by social convergence - except for the scope of national security, related to the number of homicides. The poorest regions are growing faster than the richest regions, both in terms of per capita income, and in terms of living conditions and well-being, especially in health and education.

From the third column of the Tables 4 to 11 are presented the tests for β-convergence with the variables that reify the size of the government. It is necessary to mention that these government variables were placed separately due to the high correlation between them, being thus estimated four regressions for each dependent variable in study, seeking to avoid the presence of multicollinearity.

Analyzing the economic variables, the empirical evidence shows that the budget result, which corresponds to revenue less expense, seems to have a positive impact. This result is interesting as a larger surplus contributes to economic growth. The FPE shows a negative influence on economic growth at a level of more than 4%. This fact may indicate inefficiency regarding the expenditure of these resources. As for household income per capita, government variables do not seem to influence this variable. Only the variable population growth rate is significant, with a negative effect of 2%, which may indicate that income growth does not accompany population growth. The convergence velocity is lower when compared to the regression without the control variables.

Regarding education variables, government revenue and expenditure positively affect literacy, but marginally - about 0.8%. The variable years of study does not seem to be influenced by government variables. The expenses and revenues seem to increase the speed of literacy convergence and reduce the convergence of variable years of study. Variable health outcomes also show that government variables are not able to affect the growth of life expectancy and infant survival variables. By adding the government expenditure and revenue variables the speed of convergence shows a slight increase.

Government variables exert a negative impact on fertility, except for the outcome variable (deficit / surplus), which appears to have a positive influence of about 0.03%. It is worth mentioning that the convergence speed presents a slight increase when the FPE variable is added. The non-homicide variable continued to have significance only in the pooled model, and the empirical evidence shows that government variables are not capable of influencing crime reduction.

A possible explanation for the little effect of government variables on the growth rates of social variables is based on the temporal amplitude of the analysis. Changes in structural variables generally occur in the long run. Considering all the serious problems that the country has, especially in terms of health and education, the solution would require a great deal of effort and profound changes that require a long period of time to take effect.

Herrera and Blanco (2004) estimate the short- and long-term impacts of fiscal policy on the product and find divergent results. The evidence shows that, as far as the tax aspect of fiscal policy is concerned, taxation has a relevant negative impact on the product. In relation to public spending, they do not find impact of consumption and social security spending on GDP, while subsidies have a negative effect. In the short term, government spending does not affect the output level of the economy and taxes have a negative effect.

In any case, it is known that good governance and transparent institutions are fundamental for better results in terms of public spending. In this respect, the Brazilian case is an example of inefficiency. According to the study by Alesina et al. (1999), which developed an index of budgetary institutions to measure budgetary control in 20 Latin American and Caribbean countries, Brazil performs below average, behind countries such as Uruguay, Paraguay and Chile.

Finally, even though the literature is inconclusive about the role of government as being good or bad for economic growth, it is important to note that several studies support the existence of an inverted "U-shaped" in this relationship, a condition also called the BARS curve due to research de Barro (1989), Armey (1995), Rahn and Fox (1996) and Scully (1995). In other words, the increase in public spending is beneficial up to a certain level, by exceeding that level, the impact on growth becomes negative.

In a recent perspective, Asimakopoulos and Karavias (2016) examine the non-linear relationship between government size and economic growth under a large panel dataset using a dynamic panel threshold model and the empirical results verified the theoretical BARS curve. They found that the optimal level of government size that maximises economic growth is 18.04% for the full sample; 19.12% for developing and 17.96% for developed countries. They to show that the inverted "U-shaped" non-linear relationship between government spending and economic growth is statistically significant around the optimal level, the upward and downward slopping part of the curve.

4. Conclusion

This research sought to analyze processes of convergence between the Brazilian states and the role of the government, considering not only economic variables, but also social indicators. We examined the process of σ-convergence through inequality indicators, as well as the process of β-convergence, using panel data modeling - pooled and fixed effects.

The results show a consonance between the economic and social convergence for the analyzed period, with the exception of the variable related to crime. In the analysis of σ-convergence, the variables show a decreasing trajectory in their dispersion, indicating that the states are, on average, more similar in these questions. In the analysis of β-convergence, the economic variables - GDP and per capita household income - present a high convergence speed when considering specific effects of the states. The same occurs for the variables of education - literacy and years of study. Regarding health variables, convergence is evident for life expectancy at birth, while infant survival seems to have reached its steady state.

The variable fertility rate, which refers to the demography of the states, presents significant convergence and its analysis differs from the other variables. In the Brazilian case, this result is based much more on the sharp reduction in the birth rate in the poorest regions, which occurred in the period analyzed. Crime has a conflicting result, and its convergence can not be confirmed.

As for the role of government in economic growth and convergence, the empirical evidence shows a modest effect. Considering the model with fixed effects, the results show statistical significance for three variables - GDP per capita, literacy and fecundity. The budget surplus has a positive impact on GDP per capita, contributing to economic growth. The FPE has a negative impact on economic growth, portraying the inefficiency of using this resource. Expenses and income positively influence literacy. Fertility is negatively influenced by government expenditure and revenue variables. The budget surplus exerts a marginal but positive impact on the birth rate. In most cases, the speed of convergence does not change when government variables are included.

Finally, this analysis seeks to contribute to the literature insofar as it provides empirical evidence on convergence, particularly bringing the social context and the role of government. In this sense, it is also expected to contribute to discussions of public policies, since the existence of a process of convergence or divergence may be directly related to the role of government, whether by actions already developed or that are yet to be developed.

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