Regional Development and Brazilian Constitutional Funds

Héder Carlos de Oliveira hedercarlos@yahoo.com.br
Cedeplar-UFMG

Edson Paulo Domingues epdomin@cedeplar.ufmg.br
Cedeplar-UFMG

Rafael Costa e Sousa raafel@gmail.com
Cedeplar-UFMG

Abstract: There is considerable evidence to demonstrate the high level of spatial concentration in regional development in developing countries. The aim of this paper is to analyze the Brazilian case, especially to identify if the Brazilian Constitutional Funds (FNO, FNE and FCO) have a positive impact on the regional inequality. These funds have been created in 1989 in order to finance economic activities in the North, Northeast and Centre-West regions. On one hand, our results show that regional growth in Brazil over the last 10 years has not been affected by these constitutional funds. On the other hand, public infra-structure, education and health have a positive relation with regional growth, which suggests that the public expending on those funds should be directed to these regional attributes.

Keywords: Brazil, regional economics, regional inequality, spatial econometrics.

Classification JEL: R11, R58, O18

Introduction

Brazilian economic development process occurred unequally within the country's territory, leading to huge economic and social disparity among the regions. This concentrating component of Brazilian growth model led into a society with one of the biggest worldwide inequality rate.

In the end of the XX century, the three least developed regions in Brazil – Northeast, Centre-West and North - represent together about ¾ of the territory and almost ½ of the population, corresponding for less then ¼ of the Gross Domestic Product (GDP). In 1997, the Northeast *per capita* income was less than a half of the national average. Taking others indicators, like the Human Development Index (HDI), one can notice that, even though Brazil has high average income in the worldwide economic scene, with an average rate of 0.83 in 1996, the HDI in the North and Northeast, despite the high trend of the three last decades, still

has presented, respectively, results 12.39% and 26.73% lower than the national HDI in 1996. In 1997, infant mortality rate in the Northeast was 2.6 times higher than in the South. The sanitary conditions are certainly played an important role in this result: in the Northeast, less than ¼ of the urban residence have sanitary installations connected to the general net of sewers, and in the North region this rate does not reach 10%.

According to Furtado (1997), "the disparity of income levels between Northeast and the Center-South of Brazil constitutes undoubtedly the most serious problem to be faced at the present time in the national economical development".

In this context, we tried to evaluate the contribution of Brazilian Constitutional Funds on the growth in the municipalities reached by the Funds, and consequently on the reduction of Brazilian regional inequalities.

This paper is divided in four parts. The first one is a problematic synthesis about regional development in Brazil. The second part introduces the unequal growth theories related to the argument of failed coordination. The third section presents and discusses the results found on the Constitutional Funds impact. The last part concludes the article.

1. The regional development policies

Due to the regional problems in Brazil, in the beginning of the XX century the government started to create regional development policies, which got a bigger dimension from 1950 on. These policies supported the idea that development instability in the less developed regions does not affect only these regions, but the whole country growth. Thus, the regional policies aim to correct regional instability in providing the poorest regions with the resources they need to grow to improve their social conditions, in a way to promote equal economical growth in Brazil. However, the regional development policies implemented between 1950 and 1970 did not contribute to effective inequality reduction in Brazil.

In the 80's, the dynamics of the old regional development policies was exhausted. The fiscal and financial crisis of the State, followed by a chronic inflation process, led the regional development issues to be regarded as minor priority.

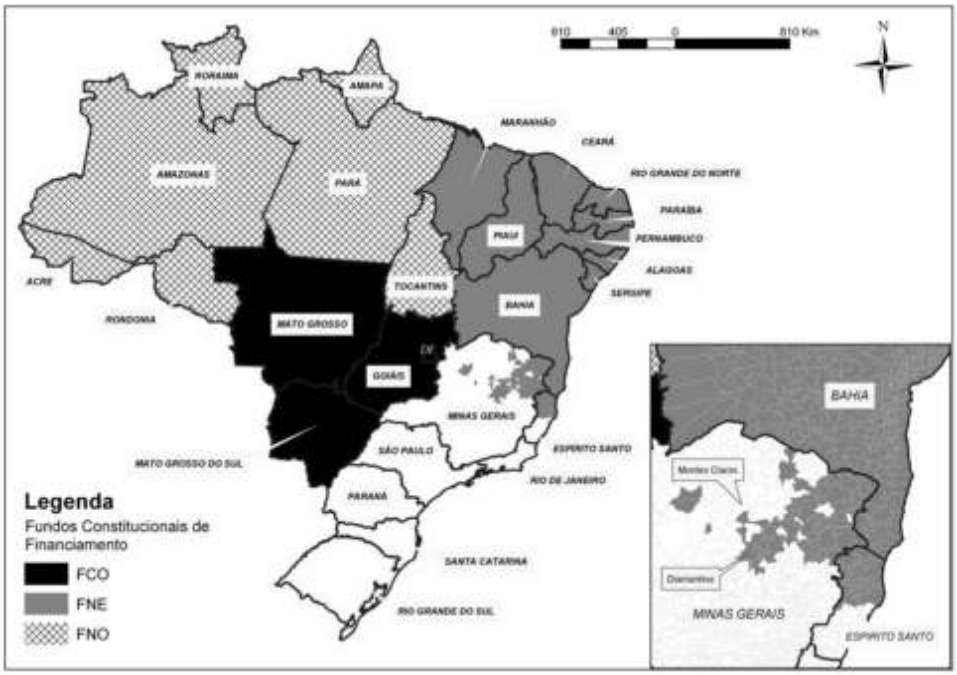
Only in the late 80's, after the promulgation of the 1988 Federal Constitution, was the regional development given more attention. The Federal Government created a structure of regional development policies that aimed the reduction of regional inequalities in Brazil. Nowadays, this regional policy structure is formed by the Ministry of National Integration,

which supervises the development funds of Northeast and Amazon (FINOR and FINAN), and the National Constitutional Funds (NFC).

Considering these aims, the Federal Constitution law nº 7.827 (27 September 1989) created the National Constitutional Funds of Centre-West (FCO, *Fundos Constitucionais do Centro-Oeste*) and the National Constitutional Funds of Northeast (FNE, *Fundos Constitucionais de Financiamento do Nordeste*). These Funds count with permanent resources that come from 3% of the total IPI - *Imposto sobre Produtos Industrializados* - (a federal excise tax on manufacturing of goods) and from IR – *Imposto de Renda* – (income taxes). The resource distribution among the Funds is 1.8% to FNE, 0.6% to FCO and 0.6% to FNO. These resources are transmitted from the Treasury Department to the Ministry of National Integration, and then retransmitted to the regional banks (Banco do Nordeste – BNB and Banco da Amazônia – BASA); these banks have the attribute of managing the resources. In the Centre-West case, Banco do Brasil (a federal public bank) have such attributions.

On MAP 1, the Constitutional Funds are represented as: (i) FNO in the North states; (ii) FNE in the Northeast region and some municipalities in the States of Minas Gerais and Espirito Santo, including the performance area of the extinct SUDENE (Superintendência de Desenvolvimento no Nordeste, the former development agency in the region); and (iii) FCO in the Center-West States.

Map 1 – Acting area of the Constitucional Funds



In consensus with to the Constitutional Funds' mission and to the lines of direction and aims established to the development of the beneficiary regions, the financial programs search great effectiveness in resource application in order to increase the productivity of companies, to create new jobs, to increase the tax collection and to improve income distribution (Ministério da Integração Nacional, 2003).

According to the Ministério da Integração Nacional (2003), respecting the nature of the regional development plans, some points must be considered in the formulation of the financial programs: (i) the financing is given exclusively to the productive sector of the beneficiary regions; (ii) more attention will be given to mini and small agricultural producers and mini and small companies, to activities intensive in raw materials and local labour and to basic food production; (iii) the action must be integrated to the federal institutions located in these regions; (iv) the actions must be concerned to environmental preservation. The programs will also support the creation of new centres, activities and development policies that could reduce social and economic disparities among regions.

Nowadays, the Funds have more resources designated to regional development. According to the Ministério da Integração Nacional (2003), the Constitutional Funds'

resources predicted to 2004 R$ 6.5 billions, allowing the enlargement of available resources, with subsided interests, for the financing of productive activities in sectors such as farming, mineral, industrial, agro-industrial, tourism, commerce and private infrastructure in the three regions.

2. Regional economic growth and its determinants

Why are some countries or regions richer, with high level of economic development, while others are poorer? Why do developed countries or regions industrialize and offer good life conditions, while other countries or regions remain on the edge of industrialization process? What are the reasons for economic growth in some countries or regions and stagnation in others?

With all these questions referring to the dichotomy between developed and developing regions, the big challenge of economic development theory is to explain the differences in economical performances among countries and regions. According to Chein Feres and Lemos (2004), the idea of unequal development is a fundamental point related to economic development theory, which includes the argument of coordination failure.

According to Matsuayama (1996), the coordination failure hypothesis intends to explain the reasons for the economic diversity among countries or regions, or the reason why poor countries and regions exist. Using a multiple equilibria model, the author argues that rich countries, in a certain way, tend to reach a Pareto-Superior situation, while poor countries fail to get the necessary coordination among the economics agents and get stuck in a so-called Pareto-Inferior trap.

For Ray (1998), in general, coordination failure occurs basically due to the interaction between history and expectations, that is, economic agents' behaviour in the present and in the future depends on the initial economic conditions as well as on expectations about the future. The initials conditions are not limited to the initial endowments of production factors or income, but also to the society structure, in terms of traditions, education, or related to the level of inequality and poverty.

To think of the reasons of disparity among countries or regions based on the argument of coordination faults, one needs to recall the some theories: the Balanced Growth Theory, developed by authors like Rosenstein-Rodan (1943), Nurske (1953), and Murphy (1989); and

the Unbalanced Growth Theory, by authors like Myrdal (1957), Hirschman (1958).

Based on the idea of Balanced Growth, Rosenstein-Rodan (1943) focuses his work on the external economies that can be achieved via industrialization, especially on a "big push" as enough industrial investments to overcome the development obstacle. This way, the author systematically supports the hypothesis of industrialization as a way to change economic structure in less developed countries and regions. In this context, if several economic sectors simultaneously adopt increasing returns technologies, each one of them would generate income, turning into a source of goods demand in other sectors, enlarging the markets and making industrialization economically possible.

Nurske (1955) developed his Balanced Growth or "big push" Model based on Rosenstein-Rodan's (1943) work. According to this model, poor countries or regions live in a "poverty vicious cycle", which makes economic development process more difficult. This implies a circular junction of forces tending to act and react one on the other, leaving a poor country in its poverty status. As a result, there is the idea that "a country is poor because it's poor".

According to Nurske (1955), perhaps the most important circular relations are those that make capital accumulation difficult in less developed economies. Capital supply is governed by the capacity and the inclination to save; capital demand is governed by incentive to invest. A circular relation exists on both sides of the problem in capital generation in poor countries or regions in the world. But what could explain, in poor areas, the problem in capital generation leading these economies to a constant process of poverty? The explanation proposed by Nurske (1955) was related to internal market size limitation.

Individual businessman in less developed areas would not find the incentive to invest because of the real limitation of market size. The difficulty caused by the reduced market size indicates the incentives of individual investments in only one production line chosen by the investor. Thus, in less developed economies, the total effort to invest would be reduced, preserving the lower Pareto condition.

The key to move countries or regions from a bad equilibrium towards a good equilibrium with stable economic growth, according to Nurske (1955), would be more or less synchronized capital application in a wide range of markets with different sectors, that is, a large-scale plan of public investments.

Based on the same argument by Rosentein - Rodan's (1943), Nurske (1955) states that

large-scale investments lead to complementarities among different industries - the industries become consumers one of the other. The market would enlarge due to the higher level of the economic efficiency, resulting in higher production capacity.

The most important theoretical formalization of the "big push" dates back to the end of the 80's by Murphy *et al.* (1989), whose objective was to understand why some countries industrialize while others do not, as well as to focus on the role of State intervention as a possible accelerator of economic growth process. In the authors' view, among several problems in economic growth faced by less developed countries, market's little size is an important restriction in industrialization process. When domestics markets are small and the international trade is expensive and not free, the industries would not be able to sell enough as to adopt increasing return technologies, making industrialization more difficult.

Murphy *at al.* (1989) started from the idea of imperfect competition with aggregate demand spillovers, and tried to study the importance of demand spillovers among sectors. To do so, they considered some stylised models of underdeveloped economies with small domestics markets and discussed how these markets could be expanded in order to free a country from the no-industrialization trap. In particular, they tried to highlight industrialization contribution in a specific sector to enlarge market size in other sectors. Such spillovers enable the coordination of investments among the sectors, which can be promoted by the government. This would be essential to industrialization, meaning that spillovers are sufficient to create a "big push". This way, the "big push" is linked to the incidence of multiple equilibrium, the latter characterized by the movement from traditional production equilibrium to industrialization equilibrium. Following the "big push" concept, the authors noticed that the interdependence between technological choice and market size are the sources of multiple equilibrium. The adoption of modern technologies with high fixed cost depends on the market size, and the market size itself depends on profits obtained from the modern technologies adopted.

In contrast, multiple equilibrium can occur naturally if one growing industry enlarges the market size of other industries, even if the first one experiments losses. This happens when an industry generates higher profits in others though other ways instead of through its own profit. In this formulation of the "big push" theory, the model presents multiple equilibrium only when the authors add the wage prize or a compensatory differential so that workers migrate from traditional production to industries. Murphy at al (1989) then

demonstrates the coexistence of two equilibriums: one in which markets are big enough to enable industries to use modern technologies; the other with markets too small to need and use such technologies. So, even if an industry presents losses, it can still beneficiate other sectors because it increases labour income and, as a consequence, its products' demand.

Murphy *et al.* (1989) also presented another important component of the "big push": investments in infrastructure, like railroads and highways. Nevertheless, for such investments, market size also matters, since great part of the costs is fixed. This is due to the fact that infrastructure construction usually depends on potential users' demand. In addition, these users can access bigger markets if the prices of their goods are reduced by the use of railroad or highways. In sum, all these transition mechanisms that can help create a "big push" are relevant to the growth of less developed countries or regions.

In contrast to the Balanced Growth Theory as originally developed by Rosenstein-Rodan, it is possible to think of economic growth process in underdeveloped areas based on the Unbalanced Growth Theory. Initially developed by Myrdal (1960) and Hirschman (1961), the Unbalanced Growth Theory tries to demonstrate that, without State intervention in the economic development process, inequalities between developed economies and underdeveloped ones tend to perpetuate themselves. Thus, an adequate and effective investment plan and a fiscal system that corresponds to the needs could reduce the social-economics inequalities.

From the Unbalanced Growth Theory, the economic delay of some regions can be thought as a process of circular and cumulative causation (Myrdal, 1960). This analysis consists in refusing the hypothesis of stable equilibrium in social reality, this is, there's no automatic tendency towards self-stabilization. The stable equilibrium is based on the idea that the social process tends to a position described as a state of forces equilibrium. However, in the author's point of view, the system does not move spontaneously toward any form of equilibrium among the forces; on the contrary, it is always moving away from this equilibrium.

Finally, Myrdal (1960) highlights the importance of policies that minimize regional disparities. Such policies should consider reforms that improve production capacity, increase productivity and provide the necessary resources to make it economically viable and to enable a social reform. In addition, the State intervention must create the conditions to make the "propeller effects" stronger and to diminish inequalities.

Hirschman (1961) also contests Rosentein- Balanced Growth Theory referring to it as identical to Say's law; for this reason, it could not be considered a developed model, once its application demands a considerable amount of resources for simultaneous development, and this resources are limited in underdeveloped countries. Thus, Hirschman argues that if a country were able to apply the balanced development doctrine, it would not be an undeveloped country to begin with.

The disagreement concerning the Balanced Growth Theory was Hirschman's motivation to elaborate a different thought regarding the problems of economic development. The main focus is to follow a deliberate policy of unbalanced growth, that is, to promote development in certain key sectors of the economy, chosen on the basis of the number of chains back and forth and its intrinsic profitability. As these sectors generate these chains, the market will respond to the non-balanced situation in the form of other spontaneous investments.

Thus, development must be regarded as an extensive process promoted by a disequilibria chain, which consists in the expansion of one sector due to the expansion of another. For instance, if one industry manages to raise its profits, it will raise its investments and the demand for products of another industry; as a consequence, these other industries will have their profits raised as well.

The disequilibria chain should be preserved by development oriented policies, reaching development via completive effect. This leads to the concept of induced investment, that is, each inversion induces new investments, working as a multiplier. Disequilibria lead to development, which creates new development, and so on.

In sum, Hirshman's (1961) studies focused on interregional and international propagation of the economic development, while Myrdal's (1960) work focused on the process of circular and cumulative causation. One important contribution of both works was to establish the idea of the intrinsic nature of unequal economic development within the space. In objection to the concept of equilibrium and convergent development, these authors defend that the presence of increasing returns in the space due to pecuniary externalities allows the creation and recreation of the relation centre-periphery in the space. One could add that, from this point, these authors were used by the economic geography theoreticians (Chein Feres and Lemos, 2004).

3. Results and Discussion

3.1 Explanatory analysis

Before presenting the econometric results, it is important to analyze the spatial behaviour patterns of the variables in order to check the occurrence of spatial autocorrelation. Such analysis is more efficient when it is part of an exploratory spatial analysis, which compares the observation behaviour in the neighbouring localities. Therefore, we built Moran's scatterplot graphics and maps from the Local Indicators of Spatial Association's (LISA) indicator. This analysis is based on the construction of Moran's I index, which test the presence of spatial autocorrelation[1].

Moran's I test is formalized as follows:

$$I_t = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(k)\, x_{it}\, x_{jt}}{\sum_{i=1}^{n}\sum_{j=1}^{n} x_{it}\, x_{jt}} \qquad (1)$$

The number of observations is given by N; w_{ij} is the elements of the weight matrix, x_i and x_j are the observations for localities i and j respectively, and S_0 is a scale constant, which refers to the total of all weight.

The formalization of LISA statistics is:

$$I_{i,t} = \frac{\left(x_{i,t} - \mu_t\right)}{m_0} \sum_j w_{j,t}\left(x_{i,t} - \mu_t\right) \quad com \quad m_0 = \frac{\left(x_{i,t} - \mu_t\right)^2}{n} \qquad (2)$$

$x_{i,t}$ being the observation in the location i in the period t; and μ_t the average of the observations within the geographic space in the period t. The summation j includes only the values of j's neighbours.

In the first place, the analysis included all municipalities in country for the year 2000. After that, we analysed only the municipalities located in the North and Centre-West, which are the regions where Constitutional Financial Funds acts, also for the year 2000.

The results in table 1 show the Moran's I statistic values for all Brazilian municipalities, their standard deviation, the Z-value statistics and the significance (p-value).

[1] For the data exploratory spatial analysis, we used the geometrical software Geoda 0.9.5-i.

Table 1 – Moran´s I statistical variables

Variable	I	Standard deviation	Z-value	Prob
Per capita Income (Y_c)	0.8198488	0.008038	102.022149	0.000000
Growth rate of Y_c	0.3157817	0.008038	39.309835	0.000000
HDI-M[1]	0.8583363	0.008038	106.810480	0.000000
Schooling[2]	0.7208214	0.008038	89.701881	0.000000
Life Expectancy[3]	0.758938 1	0.008038	94.444084	0.000000

[1] Municipal Human Development Index
[2] Proxy for Education
[3] Proxy for Health.

The Moran's I statistics is positive and highly significant (p-value = 0.000), which indicates spatial autocorrelation for all variables, suggesting the existence of agglomeration of either low or high values.

According to the Moran's I statistic results, the municipalities presenting high (low) values of the selected variables are located near other high (low) values municipalities. As an example, in the case of the municipal *per capita* income variable, this means that richer (poor) municipalities tend to agglomerate near richer (poor) municipalities. The same case is observed in the other variables presented in table 1.

Using these results, we made Moran's scatterplot graphics and maps with LISA's indicator (attached to this paper).

Moran's scatterplot graphic (Graphic 1), based on Moran's I statistics, shows autocorrelation for all selected variable. This suggests the predominance of high-high and low-low agglomerations in Brazilian regions. Thus, as shown in graphic (1b), all the Brazilian municipalities that grew the most (less) in the period 1991-2000 tend to have a neighbourhood with similar performance. One observes the same in the graphics (1a), (1c), (1d) and (1e): the relatively most developed (less developed) municipalities in Brazil[2] tend to have developed neighbours. From Moran's scatterplot, one can confirm a strong regional concentration related to the economic and social variables selected and, thus, the evidences of economic and social inequalities in the country.

The Figures based on LISA's indicator (Figure 1 – attached), also suggest that Brazilian municipalities tend to concentrate in two general categories: (i) Centre-West, South and Southeast (central regions), characterized by high-high values of the variables; and (ii)

[2] As the richest ones (with the highest *per capita* income) or with better education level, better healthy status and human development

the North and Northeast (periphery regions), characterized by low-low values of the variables. Thus, municipalities from central regions showed high rate of human development, education, *per capita* income and life expectation, followed by the neighbouring municipalities that also presented these characteristics. In periphery regions, one observes the opposite. In addition, some municipalities can be considered outliers – high valued surrounded by low valued neighbours, which can be called an economic enclaves.

Thus, comparing Figure (1a) (municipalities' per capita income) with figures (1b), (1c) and (1d), one can find information on spatial relation among social, human and economic development. In sum, we can say that the Centre-west, the South and the Southeast have the best values for the social-economic indicators, while North and Northeast regions present the worst results, supporting the problems of inequalities in Brazil.

The same spatial exploratory analysis was made for municipalities in the North and in the Centre-West. According to table 2, the Moran's I statistic is highly significant (p-value = 0.000) and positive, which indicates spatial autocorrelation for all variables; this result is similar to the analysis made for all the municipalities in Brazil. In the same way, the results of Moran's I statistic suggest the occurrence of agglomerations of low or high values also in those regions that receive the FNO and FCO.

For the contracted values of FCO and FCO, the Moran's I statistic coefficient presents a certain degree of significant and positive spatial autocorrelation, indicating that high (low) valued municipalities contracted from the Funds tend to agglomerate near other municipalities of high (low) contracted value, as it is shows on Figure (2a). However, the Funds spatial autocorrelation is less intense compared to the other variables analyzed, as we can note by the coefficient of Moran's I statistic, in table 2.

Table 2 - Moran´s I statistic variables for selected municipalities reached by FCO and FNO

Variable	I	Standard Deviation	Z-value	Prob.
Per capita Income (Yc)	0.5919201	0.020504	28.922919	0.000000
Growth rate of Yc	0.3036502	0.020504	14.863791	0.000000
Contracted Values of FNO and FCO[1]	0.0779674	0.020504	3.857080	0.000115
HDI-M[2]	0.67261 17	0.020504	32.858307	0.000000
Schooling[3]	0.4648778	0.020504	22.726974	0.000000
Life Expectancy[4]	0.4986045	0.020504	24.371849	0.000000

1 Values in million of Reais (R$).
2 Municipal Human Development Index
3 Proxy for education 4 Proxy for health.

One reason for the agglomeration of the contracted values of FCO and FNO is that, even though the financial concession is exclusively directed to entrepreneurs of productive sectors in North and Centre-West regions (that is, it includes all the municipalities in the benefited regions), Constitutional Funds in these regions work as demand resources. Thus, entrepreneurs in some municipalities get financing more easily, either because they can afford the financial commitment with the bank that manage the Funds, or because they have access to information and knowledge about the resources, or even for other economic or social factors.

3.2 The economic growth model for States using Panel Data

In this paper, the basic structure estimated is a growth model as follows:

$$Y_{i,t} = \alpha_i + X_{i,t-1}\beta' + \varepsilon_{it} \quad (3)$$

being:

i = 1,2,3,...,20 (States in the área were the Funds act);

t = 1991, 1992, ..., 2000 (periods);

$Y_{i,t}$ = GDP *per capita* growth rate differential of the states that receive the funds, in relation to the Brazilian GDP per capita growth rate;

$X_{i,t-1}$ = independent variables made of k regressors, without the constant, which are specified in Picture 1, with 1 year lag;

β' = estimated parameters for the k independent variables;

α_i = the individual effect, which is constant within time t and specific for the cross-section's individual unit i;

ε_{it} = stochastic disturbance, so that $\varepsilon_{it} \sim (0, \sigma^2_{\varepsilon})$. Besides that, $E[\varepsilon_{it}\alpha_i] = 0$ and $E[\varepsilon_{it}x_{it}] = 0$.

The panel estimation method depends on two hypotheses: (i) the individual effect α_i may be correlated to the independent variables vector, $X_{i,t-1}$ and (ii) the individual effect

may be common among the analysis units. In this context, three basic structures generalize panel data estimation. The first structure is OLS pooling, in which we assume that the specific effect α_i is fix and common among all the analysis units, that is, there is no difference among units (States). Thus, $\alpha_i = \alpha$ for all i = 1, ... N, and the OLS estimator produces efficient and consistent estimations for α and β. As a result, the economic growth model to be estimated is:

$$Y_{i,t} = \alpha + X_{i,t-1}\beta' + \varepsilon_{it} \quad (4)$$

For the second structure, fix effects, the model's formulation assumes that the differences among the units can be captured in differences in the constant term, and this, each α_i is regarded as an unknown parameter to be estimated. Moreover, the individual effect α_i is not observed; it is correlated to the independent variables, $X_{i,t-1}$, which leads to a inconsistent and biased OLS estimator. This way, model (3) can be written as:

$$Y_i = X_i\beta + i\alpha_i + \varepsilon_i \quad (5)$$

being Y_i e X_i the *n* dependent and independent variables of the i[th] unit (State), *i* is a constant term consisting of a column $(n \times 1)$ of ones (1s), and ε_i is a disturbance vector $(n \times 1)$. In this case, the intercept α_i is specific for each analysis units (States), which makes it possible to capture heterogeneity among them.

The OLS estimator becomes an efficient and consistent estimator in the model, usually called Least Squares Dummy Variable (LSDV). Equation (4) is a classic regression model, no new methods or tests are required to analyze it. As in the classic regression model, we simply regress Y_i in X_i, as well as a dummy for each analysis unit (Greene, 2001).

We can also suppose that the differences among the unities are randomly distributed and, thus, are not present in the regression. The model (3) would be then represented as:

$$Y_{it} = X'_{it-1}\beta + (\alpha + u_i) + \varepsilon_{it} \quad (6)$$

being u_i a random disturbance related to each cross section unit and constant over time.

The Generalized Least Squares (GLS) estimator is the most appropriate for a random effects model estimation. In this case, the variance of each unit is different from the

one of the fix effect model, since the variance in the GLS method is represented by the sum between the random error's variance and the individual random component.

The data used in the equation's estimation had the aim of verifying an eventual relation between Constitutional Financial Funds and some regional disparity reduction. Such data consists in a balanced panel for the Brazilian states from the North and the Middle-West, as well as the state of Minas Gerais. The panel was analyzed within ten consecutive years, in the period 1991-2000. The choice of these states was due to the fact that they receive the Funds.

The independent variables in the model consist of proxies of the structures and of the States' factors endowment, as well as of the Constitutional Financial Funds – FNO, FNE and FCO. The variables choice was based in the empirical literature, although it presents some restrains due to the available data. These variables consist in an ensemble of socio-economics and demographic measures that are usually taken into account in economic growth analysis. Picture 1 presents each one of these variables, as well as their sources and description. All the variables used in the model were lagged one year.

Picture 1 – State variables description (1991-2000)

Variables	Acronym	Source	Description
Per capita GDP growth rate differential (dependent variable)	Dif_log	IPEADATA/IBGE	GDP *per capita* growth rate of the States in the sample minus the average Brazilian GDP *per capita* growth rate
Per capita Income	Yc	IPEADATA/IBGE	Gross Domestic Product (GDP) *per capita* - Anual - R$ of the year 2000 – Deflated with the national GDP implicit deflator.
Contracted values of FNO, FNE e FCO	VC	Ministery of National Integration	Contracted values of FNO, FNE and FCO in Millions of Reais (R$).
Proxy for health status: Infant mortality rate	TMI	IBGE	Number of children that will not survive within the five first year of life, by thousand children living born.
Industry share in each State's GDP	Ind	Statistical Yearbook (2000)	States' Industrial GDP share in relation to the total GDP of each State.
Service sector share in each State's GDP	Serv	Statistical Yearbook (2000)	Service sector's GDP share in relation to the total GDP of each State.
Migration rate (only people form urban areas)	Mg	IBGE/Cedeplar	Net migration rate = migration balance/population. Migration Balance = Immigrants – Emigrants.
Proxy for physical capital stock: total electricity consumption	C_eng	Statistical Yearbook (several years)	Measured as the total electricity consumption.
Proxy for infrastructure: households with adequate water facilities	DA	IPEADATA	Percentage of population living in households with water facilities from the general network.

3.2.1. The Panel Data Model for States

Firstly, we estimated the economic growth model by OLS (Pooling or aggregate data), fixed and random effect panel.

The estimation by pooling OLS together with random and fixed effect panel aimed to check an eventual efficiency gain in its results in relation to the simple pooling-OLS estimation. In addition, the pooling OLS estimation allows us to confirm the existence of multicollinearity in the model by the Variance Inflation Factor (VIF) statistic. According to Judge *et al* (1982), there is severe multicollinearity when the VIF statistic value is higher than five. In our model, the VIF statistic resulted 2,6, rejecting the hypothesis of multicollinearity among the variables.

On Table 3, one can see there is no efficiency gain when we estimate the model by panel data for fixed and random effects, in comparison with the pooling OLS estimative.

Table 3 – Results for the pooling OLS and panel data estimation (Fixed and Random effect)

Dependent variable: States' *per capita* GDP growth rate differential (1991-2000)			
	Pooling OLS	**Fixed effect**	**Random effect**
Constant	0.028^{+} (0.7781)	0.742*** (0.1794)	0.028^{+} (0.7781)
Per capita GDP (Yc)	-0.068*** (0.1618)	-0.223*** (0.0357)	-0.068*** (0.1618)
Funds (VC)	0.000075^{+} (0.0000843)	0.000101^{+} (0.000128)	0.000075^{+} (0.0000843)
Infant Mortality (TMI)	-0.002*** (0.0005)	-0.004*** (0.0011)	-0.002*** (0.0005)
Industry share (Ind)	0.003** (0.001)	0.002^{+} (0.0028)	0.003** (0.001)
Services share (Serv)	0.001^{+} (0.0008)	0.005** (0.002)	0.001^{+} (0.0008)
Migration (Mg)	-0.005** (0.0019)	-0.004^{+} (0.0032)	-0.005** (0.0019)
Electricity consumption (C_eng)	0.048** (0.0205)	0.042** (0.0206)	0.048** (0.0205)
Households with water facilities (DA)	0.116** (0.0488)	0.109^{+} (0.0786)	0.116** (0.0488)
VIF	2.6	---	---
R^2	0.1495	0.2874	0.1495
Adjusted R^2	0.1139	---	0.1139
F test	4.20***	8.67***	---
Wald test	---	---	33.58***
Breusch-Pagan LM calculated $\chi^2 = 0.42$ Prob > $\chi^2 = 0.000$			
Hausman test	n.a.[a]		
Number of observations	200	200	200

Note: (***) Statistically Significantly at the 1% level; (**)Statistically Significantly at the 5% level; (*)Statistically Significantly at the 10% level; ($^{+}$) Not Statistically Significantly. Standard errors are provided in parentheses.
a – Not applicable because the estimator of the random effect degnerated for estimator OLS pooling.

Table 3 presents two specification tests. Firstly, Breusch-Pagan LM test is used to test the statistic significance of the State's random effect. The result of this test leads us to accept the null hypothesis (p-value = 0.000): the no-effect model is more adequate, that is, the model with no random effect. Hence, the individual effect α_i does not exist in the analized

States, which points to the use of the pooling OLS panel estimation instead of the fix or random effect panel. Secondly, using the Hausman method we tested orthogonality in specific State errors with the independent variables. The random effect model tended to zero, which means that this specification does not differ much from the pooling OLS estimator.

As a result, the economic growth model estimation was made by pooling OLS. Before we analyze the results, some tests were made in order to identify econometric problems that could lead to biased estimative and inconsistent parameters. Two of the worries refer to the possibility of heteroskedasticity and serial correlation.

Firstly, in order to check normality among the residuals, we used Shapiro-Wilk (1965) test, as well as a combination of skewness e kurtosis tests. In both tests, the null hypothesis states that the data are normally distributed. The results lead us to accept the hypothesis that the residuals have normal distribution at 1% significance level.

After that, we used the Breusch-Pagan (1979) e White (1980) statistic tests to detect heteroskedasticity in the errors distribution. Both tests have $\chi^2(p)$ distribution, according to the null hypothesis of homoskedasticity. Bothe pointed to the presence of heteroskedasticity in the model, as shown in table 4.

Table 4 – Normality and heteroskedasticity tests in the residuals

Normality tests				
		W test: Shapiro-Wilk		
Variable	W	V	z	Prob > z
Residuals	0.9937	0.933	-0.159	0.5631
		Skewness/Kurtosis tests		
Variable	Pr (Skewness)	Pr (Kurtosis)	Adj $\chi^2(2)$	Prob > χ^2
Residuals	0.838	0.131	2.35	0.3096
Heteroskedasticity tests				
Breusch-Pagan LM test: $\chi^2(9) = 27.35$		Prob > χ^2 = 0.001		
White test: $\chi^2(44) = 55.30$		Prob > χ^2 = 0.1181		

With the aim of correcting heteroskedasticity, we estimated the gorth model by the Weighted Least Squares (WLS) method; in our case, weighted with the total urban migration (Mg). After the WLS estimative we did once more the Breusch-Pagan (1979) e White (1980) tests. The results in both tests lead us to accept the null hypothesis of homoskedasticity. Hence, the growth model should be consistent and non-biased, which conforms the WLS method efficacy for heteroskedasticity correction, as shown in table 5.

Table 5 – Model comparison by OLS and WLS

	Dependent Variable: *Per capita* **GDP growth rate differential**	
	OLS	**WLS**
Constant	0.028^{+} (0.7781)	-0.15^{+} (0.138)
Per capita GDP (Yc)	-0.068^{***} (0.1618)	-0.112^{***} (0.0246)
Funds (VC)	0.000075^{+} (0.0000843)	0.000146^{+} (0.000167)
Infant Mortality (TMI)	-0.002^{***} (0.0005)	-0.003^{***} (0.001)
Industry share (Ind)	0.003^{**} (0.001)	0.006^{***} (0.0015)
Services share (Serv)	0.001^{+} (0.0008)	0.004^{***} (0.0016)
Migration (Mg)	-0.005^{**} (0.0019)	-0.147^{**} (0.0061)
Electricity consumption (C_eng)	0.048^{**} (0.0205)	0.082^{***} (0.0305)
Households with water facilities (DA)	0.116^{**} (0.0488)	0.17^{**} (0.8145)
R^2	0.1495	0.282
Adjusted R^2	0.1139	0.2263
F test	4.20^{***}	5.06^{***}
	Breusch-Pagan LM test	**Breusch-Pagan LM test**
	$\chi^2(9) = 27.35$	$\chi^2(9) = 10.44$
	Prob > χ^2 = 0.001	Prob > χ^2 = 0.316
	White test	**White test**
	$\chi^2(44) = 55.30$	$\chi^2(44) = 48.10$
	Prob > χ^2 = 0.1181	Prob > χ^2 = 0.31

Note: (***) Statistically Significantly at the 1% level; (**)Statistically Significantly at the 5% level; (*)Statistically Significantly at the 10% level; ($^{+}$) Not Statistically Significantly. Standard errors are provided in parentheses.

Finally, we tested first order serial autocorrelation in the residuals – AR (1) – comparing the estimated ρ by the Prais-Winsten (1954) method and the estimated critical values of the Durbin-Watson statistic. Table 6 shows that the Durbin-Watson statistic calculated for the economic growth model estimative resulted in 2.047. For the critical values

in the Durbin-Watson statistic table, ρ is beyond the maximum limit of the critical value, which suggests that there is no first order serial autocorrelation in the residuals.

Table 6 – First order autocorrelation test – AR(1)

Durbin-Watson statistic (original)	**Durbin-Watson statistic – inferior limit**	**Durbin-Watson statistic superior limit**
d_w = 2.047	d^*_i = 1.686	d^*_s = 1.852
N = 200	k = 9	

N = number of observations; k = number of independent variables, including the constant term.

From Table 5, one notice that the F test for this model points to coefficients' collective significance at a level lower than 1%, even though the individual coefficient of Funds values (VC) does not present a high significance level. The signs of the following variables – electricity consumption rate, infant mortality rate, households with water facilities, industry share and service share – behaved as expected. Their coefficients were highly significant (p-value = 0.000), which confirms the relation between social and infrastructure variables and economic growth process.

The relation between *per capita* GDP growth rate differential and the Funds (VC) is not significant, even though it is positive. This suggests that the Funds , as a regional development policy option, is not delivering the expected results in terms of *per capita* GDP growth in the States of the North, Northeast and Centre-West in a way to reduce regional disparity, which is the explicit aim of the Funds.

Although total urban migration turned out be significant (p-value = 0.000), it does not present the expected sign[3]. The sign of this variable is negative, which points to an inverse relation between urban migration in the States of the North, Northeast and Centre-West and the economic growth in these States. One possible reason for this result could be based in Myrdal's (1960) argument that the relation between migration flux and economic growth

[3] One would expect this variable to have positive sign, that is, migration would be positively related to economic growth. One explanation for this is that a high capacity to attract labour force is a result of interregional differentials of wage rate and occupation rate.

tends to be different within different regions. Thus, more developed regions keep on taking the advantages of migration process, while the less developed regions tend toward stagnation.

This probably occurs due to the fact that peripheral regions (North, Northeast and Centre-West of Brazil), even though presenting "economic opportunities", do not get to determine the direction of a high-skilled migration flux. A great part of the labour force coming towards these regions has lower skills than the new business would demand. The several usually low-skilled migrants face problems of market absorption, i.e., they do not succeed in integrating the local economy. Hence, the migratory flux towards less developed regions may not promote market enlargement because it does not present better possibilities in productively integrating the labour force originated by migration. This had neutral or negative effect in economic growth.

The *per capita* GDP coefficient is significant and negative, which suggests that the States that had lower initial level of *per capita* GDP tended to grow more than the national average, if compared to those States with higher GDP. However, since the regressions are controlled by several other variables, we can affirm that the poorest States are not moving towards the *per capita* GDP level of the richest States in the North, Northeast and Centre-West, or even towards the national average. They are converging to their own level of long-term equilibrium.

According to the estimation, the variables "industry share" and "services share" are significant and directly related to economic growth rate in those States that receive the Funds. This suggests the occurrence of economies of scale and / or scope as a result of the agglomerative effect of these sectors, which contributed to economic growth. Besides the possible internal economies of the firms, the external economics generated by these sectors were rather important, as it allowed a differentiated economic growth in the less developed States. As pointed by Roseinstein-Rodan (1943), this fact may have been pushed by the "big push" of the articulated sequential investments.

According to Murphy *et al* (1989), the industrialization process tends to

contribute to the expansion of the market in other sectors, since the industry sector generates spillovers as to promote the "big push". Thus, the "big push" leads to market enlargement, which promotes economic growth and help States to move from the poverty trap.

The variable "households with water facilities" (proxy for infrastructure) also presented a significant and positive relation to the GDP growth rate differential. This result points out the direct relation between economic growth and a better infrastructure in the States, which supports the argument presented by Murphy *et al* (1989). According to these authors, investments in infrastructure are important in order to promote the "big push" and, thus, are necessary to generate the economic growth process in the less developed States. It is therefore important that the Funds resources are directed also to infrastructure generation as a way to create the conditions for the "big push", and this way, promote economic growth in the peripheral regions where the Funds act.

In the case of infant mortality (proxy for health), the coefficient is negative (-0.003) and significant at 1%. These results show that bad health status tends to make economic growth more difficult. The worst health statues can be represented as a great infant mortality. Hence, those States with the lowest levels of infant mortality presented the highest *per capita* GDP growth rate.

4. Conclusion

The objective of this paper was to analyze the available empirical evidence on the impact of Constitutional Development Funds of North, Northeast and Centre-West on the reduction of regional inequality in Brazil. The impact of these funds' expenditures is obviously not restricted to the growth of per capita income. Socioeconomic indexes such as income distribution, poverty, human development, among others, may have been even more affected than per capita income. In addition, significant improvement in these indexes due to the Fund's impacts would probably reflect on municipalities' per capita income and municipal economic growth in long term.

The results presented in this paper suggest that the Development Funds' impact was very low in the growth differential of States in the North, Northeast and Centre-West in the

period between 1991 and 2000. Taking this hypothesis as true, we then should discuss what causes such inefficiency, because the implicit objective of Funds is the reduction of regional inequality. The data presented in this work do not allow us to analyse this question. To do so, it would be necessary to make a microfinancing analysis of the financed economic activities, interest rates etc. However, a few hypotheses can be raised. The Development Funds are essentially oriented towards the demand side: they are requested by the local economic activities that fit the requirements of the Development Funds. Thus, probably, only less developed activities in municipalities with better access to information and banking infrastructure will apply for those resources. For regional planning matters, there is no line of direction for resources sectorial or regional allocation. Therefore, if the resources are allocated only by the market forces, activities in less developed areas or sectors will probably not be reached. As a result, the Development Funds impact tends to concentrate in richest municipalities of its designated area.

Given the "demand-oriented" character of the Development Funds, which leads to resource concentration in a few municipalities in the beneficiary areas, regional planning policies for the Funds are necessary as a way to overcome or to attenuate the problems of market failure, which leads to unequal development among Brazilian States.

From the regional planning of FCO, FNO and FNE, more coordination among economics agents can be expected. This would enable the States of North and Centre-West, stuck in a poverty trap, as Myrdal (1960) says, to create mechanisms of incentive to the investments as a way to influence the existing structure and, thus, create the conditions to overcome the initial structure of inequalities and poverty they are inserted.

Bibliography

Anselin, L. SpaceStat tutorial – a workbook for using SpaceStat in the analysis of spatial data. University of Illinois, 1992. 250p.

Anselin, L. (2002). Under the Hood. Issues in the Specification and Interpretation of Spatial Regression Models. Regional Economics Applications Laboratory (REAL) And Department of Agricultural and Consumer Economics University of Illinois, Urbana-Champaign.

Chein Feres, F.L. Lemos, M.B. Desenvolvimento desigual, falhas de coordenação e Big Push. In: José Raimundo Carvalho; Klauss Hermanns. (Org.). Políticas Públicas e Desenvolvimento Regional. Fortaleza, 2005, v. , p. -.

Conley, T. G. (1999). GMM estimation with cross-sectional dependence. Journal of Econometrics, 92:1–45.

Furtado, Celso. Obra autobiográfica. Paz e Terra, 1997.

Greene, W.H. Econometrics Analysis. Fifth Edition. New York University, 2003.

Hirschman, A .*The strategy of economic development.* New Haven: Yale University Press, 1958.

Kelejian, H. H. & Prucha, I. (1998). A generalized spatial two stage least squares procedures for estimating a spatial autoregressive model with autoregressive disturbances. Journal of Real Estate Finance and Economics, 17:99–121.

Kelejian, H. H. & Prucha, I. (1999). A generalized moments estimator for the autoregressive parameter in a spatial model. International Economic Review, 40:509–53 3.

Matsuyama, K. Why are there rich and poor contries? Symmetry-breaking in the world economy. Journal of the Japanese and International Economies. 10. p. 419-439, 1996.Ministério da Integração Nacional. Fundos Constitucionais de Financiamento. [www.integracao.gov.br], 2003.

Murphy, Kevin M.,Shleifer, Andrei e Vishny, Robert W. Industrialization and the Big Push. The Journal of Political Economy. Volume 97 (5). Outubro, 1989. Myrdal, G. Economy theory and under-development regions. Cap. 3/4. Londres, 1957.

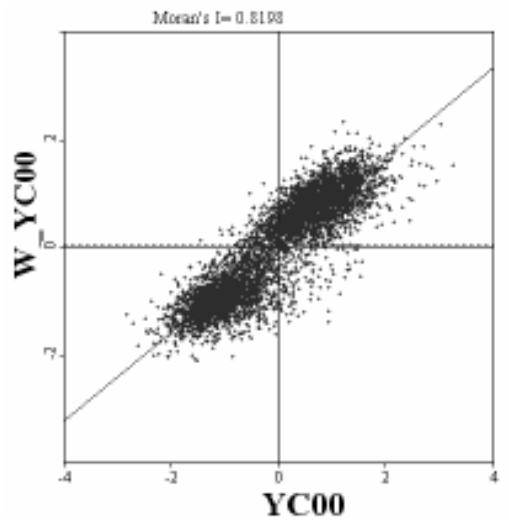
Nurske, Ragnar. Problems of capital formation in underdeveloped countries. Nova Iorque: Oxford University Press, 1967 (1ª Impressão, 1953).

Ray, D. Development Economics. Princeton Universty Press. Princeton: New Jersey, 1998.

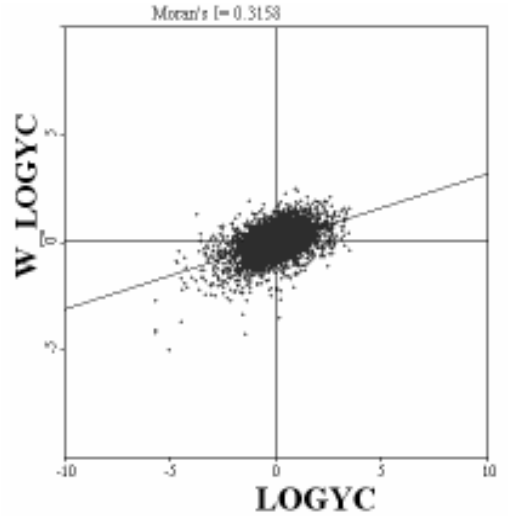
Rosenstein-Rodan (1943), P. Problems of industrialization of Eastern and Southeastern Europe. Economic Journal. 53. p.202-21 1. In: MEIER, Gerald (ed.). Leading issues in economic development; studies in international poverty. Oxford University Press, 1971.

ANEXX I

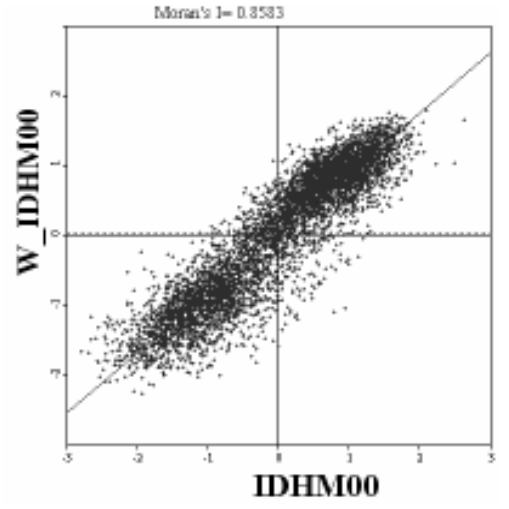
Graphics 1: *Moran' scatter plot* to selected variables.



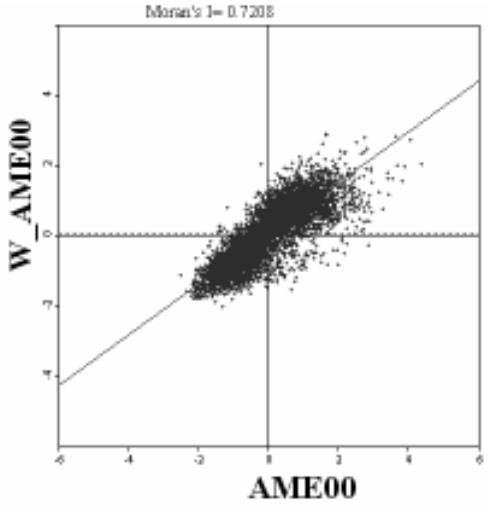
Graphic 1 (a): *Moran scatterplot* to per capita income



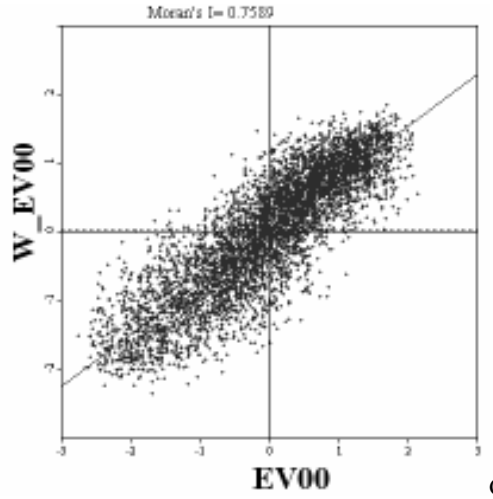
Graphic 1 (b): *Moran scatterplot* to growth per Capita income tax – 1991/2000



Graphic 1 (c): *Moran scatterplot* to HDI



Graphic 1 (d): *Moran scatterplot* to average years of study of people with of 25 or more years old, 2000.



Graphic 1 (e): *Moran scatterplot* to life expectancy, 2000.

Anexx II

Figure 1: *Moran scatterplot* to selected variables: Brazil

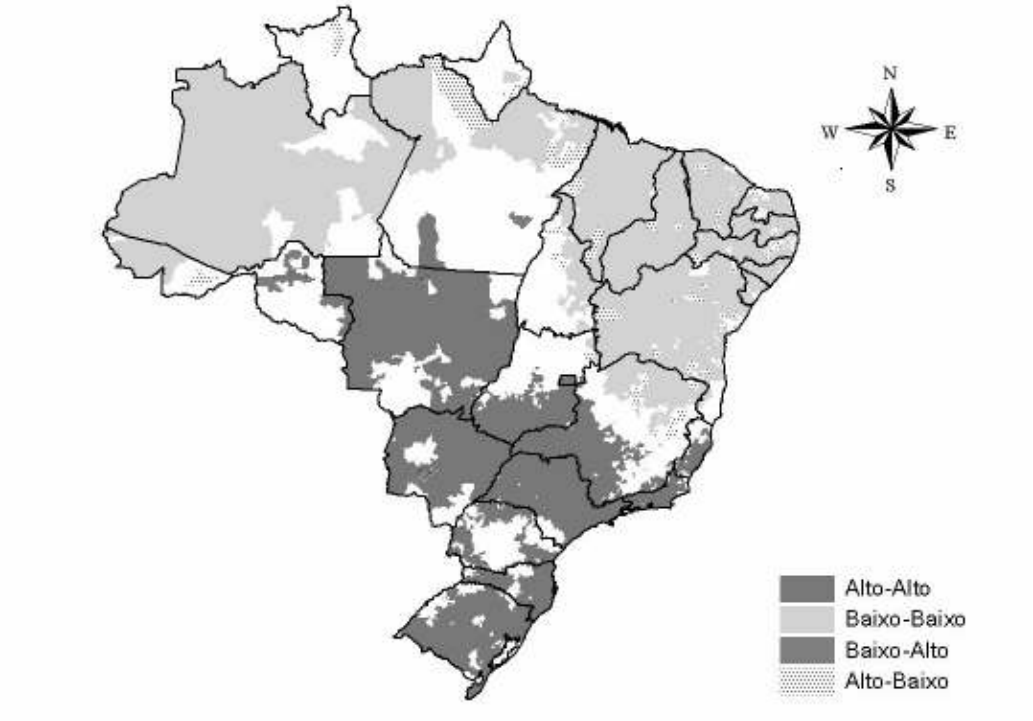


Figure 1 (a): Spatial distribution of *per capita* income, 2000.

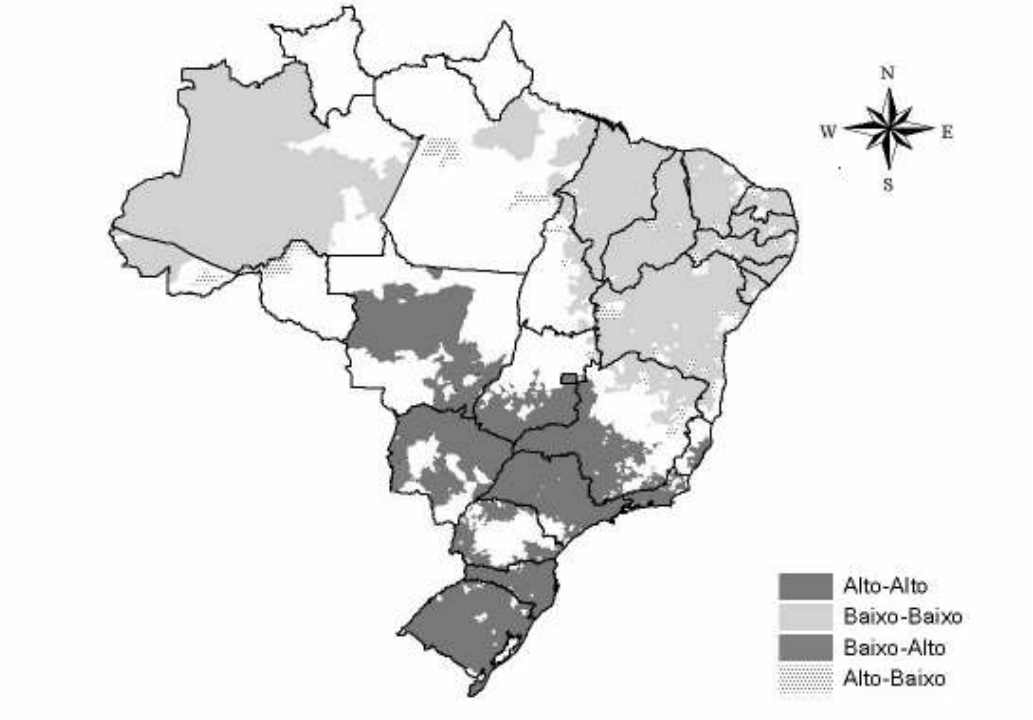


Figure 1 (b): Spatial distribution of HDI, 2000.

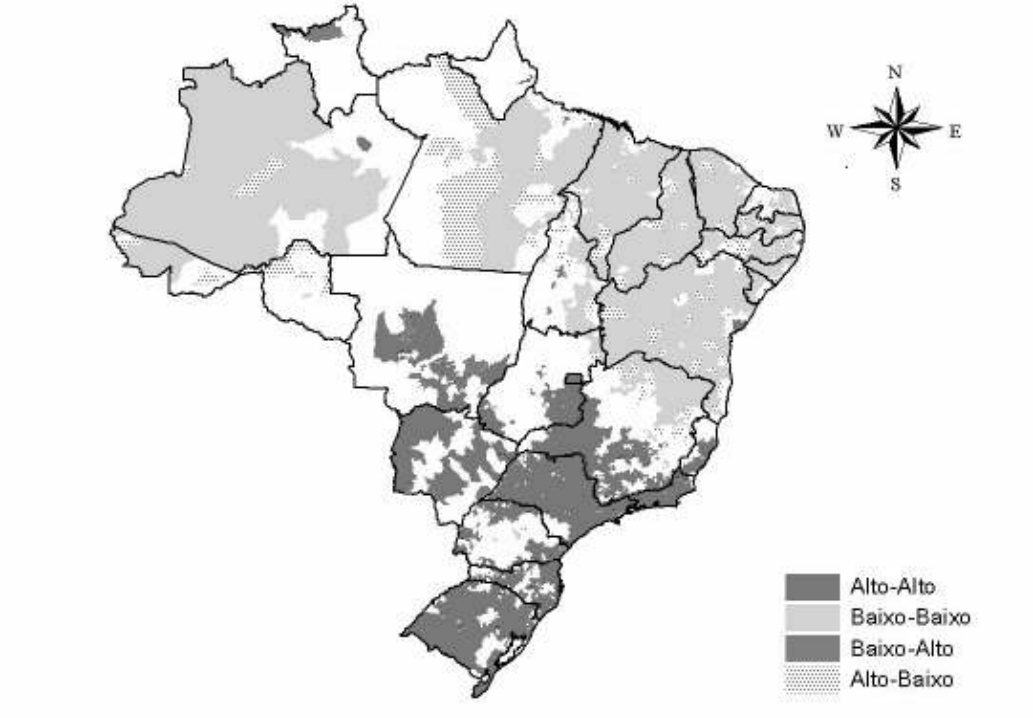


Figure 1 (c): Spatial distribution of Schooling (average years of study), 2000.

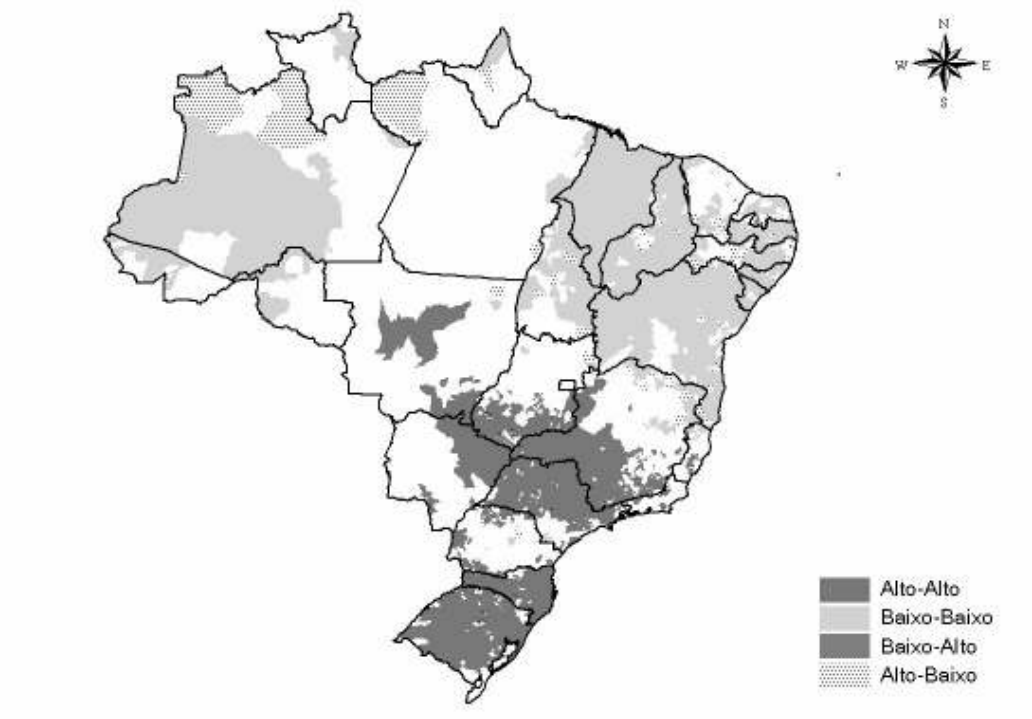


Figure 1 (d): Spatial distribution of life expectancy, 2000

Anexx III

Figure 2: *Moran scatterplot* to selected variables: North and Centre-West regions

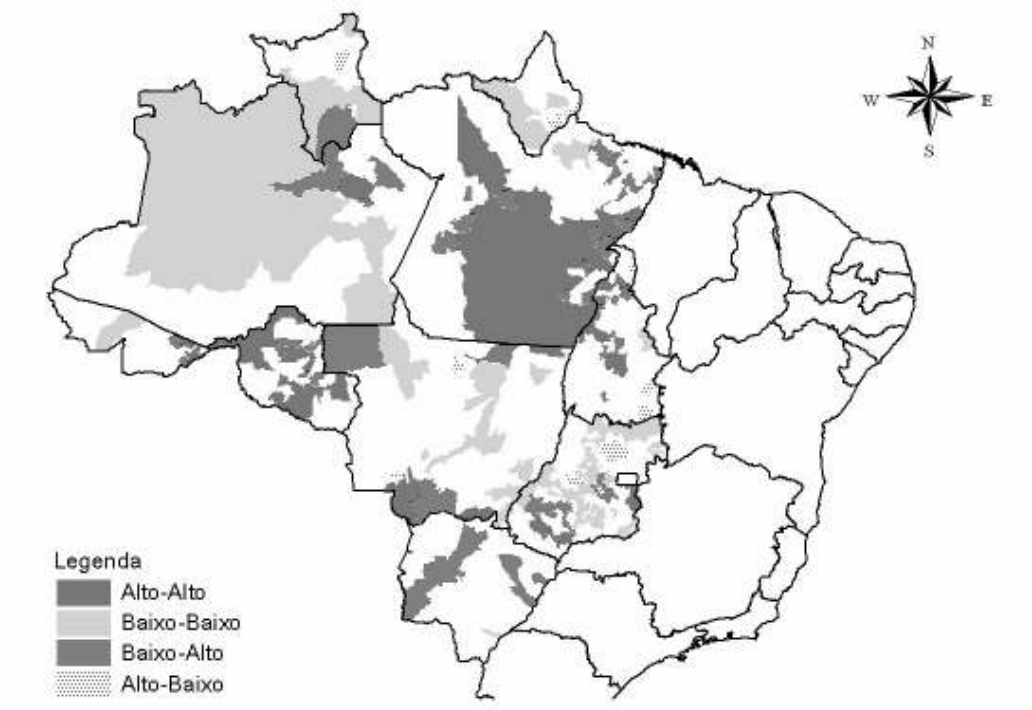


Figure 1 (a): Spatial distribution of FNO and FCO, 2000.

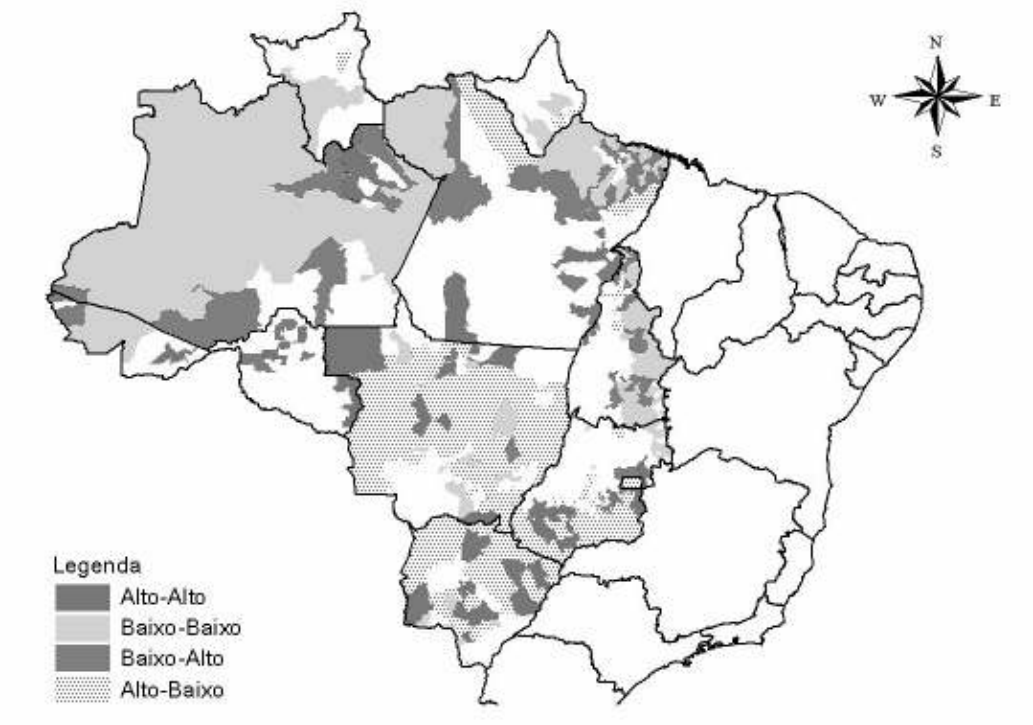


Figure 2 (b): Spatial distribution FCO/FNO versus *per capita* income, 2000.

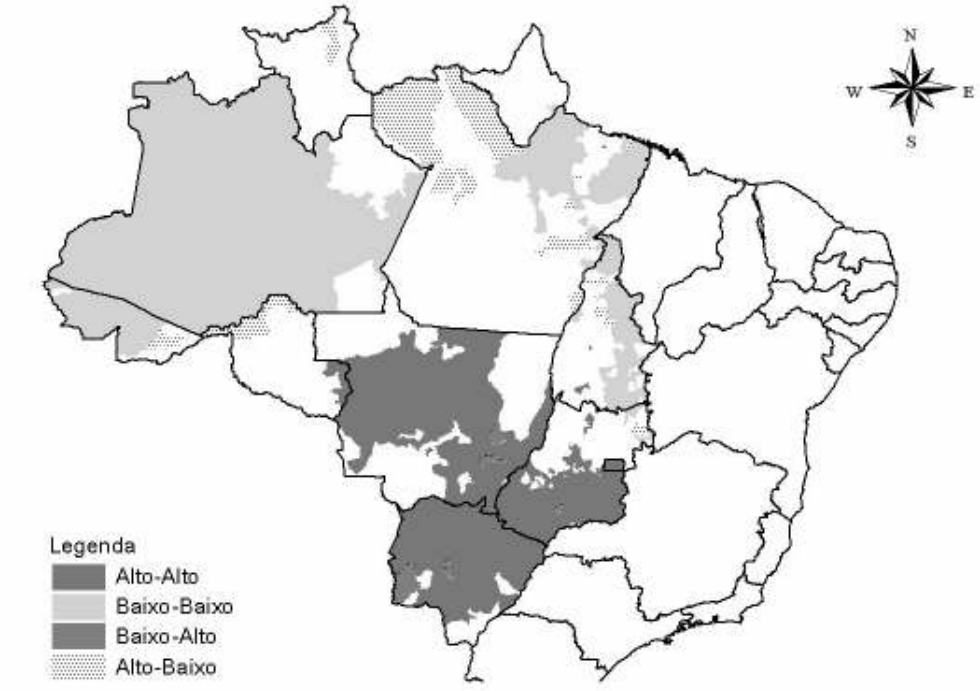


Figure 2 (c): Spatial distribution of HDI , 2000.