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ECONOMIC GROWTH IN BRAZIL: AN APPROACH ABOUT CAPITAL ACCUMULATION AND INSTITUTIONS

Crescimento econômico no Brasil: Uma abordagem sobre a acumulação de capital e instituições

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Abstract: This article contributes to the discussion of the relation between human capital, institutions and economic growth. First it is presented the micro foundations that link the institutions to human capital, according to Dias and Tebaldi (2012). The advantage of modeling this strategy is that the accumulation of human capital is derived from an endogenous process. The theoretical model shows that improvements in the quality of institutions turn the accumulation of human capital faster, reduce income inequality and change the historical path of development. The differential about this article is that it uses a panel of data from Brazilian states in the period from 2002 to 2008, for testing some prepositions of the model and finds that structural and political institutions affect the long-term performance of the economy.
Keywords: Human Capital; Institutions; Econonomic Growth.

Resumo: Este artigo contribui para a discussão da relação entre capital humano, instituições e crescimento econômico. Primeiro, são apresentadas as microbases que vinculam as instituições ao capital humano, de acordo com Dias e Tebaldi (2012). A vantagem deste modelo é que a acumulação de capital humano é derivada de um processo endógeno. O modelo teórico mostra que as melhorias na qualidade das instituições transformam a acumulação de capital mais rápida, reduz a desigualdade de renda e muda a direção histórica de desenvolvimento. O diferencial sobre deste artigo é o uso de um painel de dados dos estados do Brasil no período de 2002 a 2008, que testa alguns preposições do modelo e descobre que estruturas e instituições políticas afetam o desempenho a longo prazo da economia.
Palavras-chave: Capital humano; Instituições; Crescimento Econômico.

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1 Introduction

One of the biggest intentions of economic growth studies is to explain the income gap among countries and even the existing income gap within a country, such as Brazil. The concern in demonstrating how physical and human capitals are combined to explain the difference in the growth rate of a country is the subject of several studies relating this theme.

In recent years, a new sort of research has been gaining ground in the academic debate, giving the institutions a leading role in the discussion of issues related to economic growth. In this sense, several studies discuss the role of institutions on the process of economic growth of countries, seeking to understand how they can contribute or not to the reduction of regional disparities, that is, in the discussion about the income gap between countries.

Some works, such as Acemoglou et al. (1996; 2002; 2005a; 2005b), among others, show that the institutions can affect the growth process of the countries directly, that is, its impact on economic growth is seen by its direct inclusion in the production border. Authors such as Dias and Tebaldi (2012) argue that its role can be seen through the performance it has on human capital and on physical capital, on the other hand, affects the long-term actions in the economy. In this context, to study and understand the microeconomic foundations of this relationship is important as it allows us to observe how institutions affect the economic performance of a population.

Microeconomic fundamentals that establish the link between the levels of human capital in the economy as determined by the institutions were proposed by Dias and Tebaldi (2012). The model of the authors indicates that the quality of institutions affects the rate of return on human capital and therefore their decisions to accumulate human capital in the long-term , more precisely, going from non-educated to an educated condition. This formalization results in the fact that the ratios between educated and non-educated, over time, are determined by the quality of the institutions of the countries. Good quality institutions tend to promote the accumulation of capital because they increase their rate of return. The opposite occurs with the predominance of low quality institutions. The authors tested the effects of the ratio educated/non-educated on the long-term economic growth, proving, indirectly, the role of the quality of institutions.

This paper is a continuation of econometric tests when checking the effect of institutions on the level of human capital as well as when observing the impact of the institutions and physical and human capital accumulation on the growth rate of GDP *per capita* of Brazil. The approach of this work is importante because it is defined at State level of the Federation. This definition is very important because most of the work involves the approach between countries and to consider the territorial extension and the existing income inequality in Brazil, taking into account this dimension can contribute to the understanding of the nuances that affect the country's economic growth.

The institutional variable used in this article, will be tested for the ratio of educated people, that is, the percentage of workers with over 11 years of studies, and the non-educated, meaning, workers with no scholarity. The creation of this *proxie* for the institution is called by Dias and Tebaldi (2012) structural institution. According to the authors, if the model is correctly specified, the steady-state conditions imply that the structural institutions are persistent and rooted in the historical development path of the economy, this, in its turn, can be approximated by weighting educated labor, in economy, affirmation captured by the ratio of educated and non-educated workers.

Furthermore, here extends the definition of human capital to consider two other Macro-Mincer settings. The first is proposed by Hall and Jones (1996) and conceptualizes human capital as quadratic, with diminishing returns. The second is proposed by Trostel (2004) and view human capital as well as non-linear, but it has increasing returns. The intention is to change both settings to consider the average experience of individuals in each State, important aspect of *learning by doing* process proposed by Arrow (1962).

This paper is organized in the following way: section 2 presents a brief literature review, in which it emphasizes mainly the role of institutions on the process of economic growth. Then, in section 3, it talks about the theoretical model - Dias and Tebaldi (2012), which serves as basis for empirical

purpose of this article. In Section 4, the database and the econometric model are presented, while in Section 5, the results of the work are discussed. Further, final considerations.

2 The role of Institutions on Economic Growth

The definition of institutions in the economic literature is very wide and the way it acts in the economic system is a source of much controversy. Briefly, one can conceptualize it as North (1990), the way the institutions are seen, *"the rules of the game in a society, or more, formally, are the humanly devised constraint that shape human interaction"* that is, they shape human actions and promote interaction between people. In this meaning, the author includes formal institutions (rules, laws, etc.) and informal limitations (customs, conventions, traditions, codes of behavior etc.).

In this sense, Acemoglu (2009) explains that the institutions can affect the economic system, through incentives that enable investments in technology, physical capital and human capital, and are the fundamental cause of economic growth as well as the explanation for the differences in economic performance of countries. The author adds that institutions differ from geographic and cultural variables because they are the product of social choices and, therefore, can be restored so as to obtain desired results.

In this context, several studies dealing with the relevance of the institutions on the process of economic growth of countries, seeking to understand how they can contribute or not to the reduction of regional disparities, that is, in the discussion concerning the income gap between countries or even within the country, such as Brazil.

Regarding this institutional relationship with economic growth, it would be conceivable to ask: How institutions affect the economy? How to measure this behavior? What factors to consider in the definition of institutions? In this sense, Acemoglu (2009) states that institutions must provide the interactions between individuals, including economic, political and social relations between individuals, families and businesses. Thus, understanding the process of formation of the institutions and how they are outlined, becomes crucial for understanding its role in long-term growth of countries.

The fundamental hypotheses brought up by researchers on this theme, consider that the economic institutions must affect the economic stimulus, for example, if a country has better conditions to guarantee the right of ownership, it is likely that in this country, there are more incentives for research and adoption of more effective technologies, and greater incentives for investment in physical and human capital, in a way to affect the economy product. In societies where this process is more bureaucratic and expensive, it is likely that incentives for physical and human capital accumulation are lower, since there are not many guarantees of patents and possibly, returns on investments in accumulation are smaller on those societies (ACEMOGLU, 2005a). In this sense, the actions of the market and the government can contribute to the dynamism of this process.

Still in the theoretical discussion, Bueno (2004) contributed to the institutional debate by summarizing the main methodological factors and the main propositions inherent to the New Institutional Economy, also presenting the propositions that could be empirically tested regarding the evolution of governance structures and institutional matrix. In this paper, the author presented an important comparative review between Transaction Costs Theory and Collective Action Theory showing that each of these problems need to be addressed with different instruments and strategies since the problems are of a different kind.

The empirical applications of this analysis have been widely discussed, because, apart from the theoretical specifications involved in this process, it is also needed caring for the econometric techniques, data and *proxies* to be used. In carrying out the empirical test of the role of institutions in relation to economic growth, Acemoglu et al. (2005a) observed a clear correlation between a measure of institution *(protection against expropriation risk)* and *per capita* income.

The data analyzed by the authors show that countries with higher incomes also tend to have greater protection, which confirms the hypothesis of this work, that is, countries with higher growth are those with better institutions.Considering the fundamental assumption that good institutions

tend to generate better economic results, it would be, then, expected that the political and economic agents would always seek improvement in the institutional process, in order to achieve improvement in product savings. In this sense, Acemoglu (2009) notes that the process is not so simple, because the institutional issues relate to conflicts of interest in society, not always easy to arrange, considering that the interests are multiples and some win and others lose.

Wolf (1995) analyzed how the social context can influence economic behavior. For the author, the institutions are able to stimulate or prevent the adoption of new technologies as well as the formation of productive capital. This way, they can be considered productive, in the same way as the capital and technology. In its definition of institution, the author refers to political organizations, both public and private, noting that the institutions can affect social behavior, leading to economic growth in many effects, among them, the calculation of costs and benefits, in a way to affect the profit of the entrepreneur, the relationship between production and distribution, of both, product and income, the order of predictions and probabilities of economic relations. That is, he considers the judjement, both collective and individual of what is desirable, knowledge of economic opportunities, such as reducing imperfections and rigor of the market, motivations and values related to the risks and to predicting the result of certain economic actions and gain probability associated with these consequences.

Levine (2005) considers the right of ownership crucial to the process of economic development. The work of Knack and Keefer (1995) and Hall and Jones (1999) show empirically an association between the degree of privacy protection and economic development. For Levine (2005), the degree of privacy protection, seen as a right, does not occur naturally, but tied to social institutions and political choices. Part of two views: *Law view*, explaining the differences in legal traditions formed for centuries in Europe in which colonization was spread, he also explains the difference between the property rights between countries; *Endowment view*, differences in natural resources, climate, the native population and the environment affect the construction of institutions and continue to impact the right of ownership, today. The results of the estimates indicate that property rights affect the freedom and prosperity of the nation

Bouis and Murtin (2011) sought to identify the effects that the institutions and policies cause on production growth. Studies made by the OECD covered an average of 20-22 countries and proposed a regression alternative to correct the problems usually obtained in conventional regression analysis. It was used as dependent variable the GDP growth rate *per capita* of the population, 15-64 years, expressed in PPP (purchasing power parity) and as explanatory variables accumulation of physical and human capital, the rate of population growth as well as institutional variables, such as government size indicator, inflation measures, research and development intensity, financial development and trade openness.

In this work, the authors concluded that the human capital ratio, measured as an additional year of scholarity, has an impact approximately 10% over the *per capita* produce growth, but this estimation is not robust for all estimates. Some policies and institutions, especially trade liberalization, are associated with higher speed of convergence of Production Border for stable state and, through this channel, relate to higher growth of the long-term *per capita* income, there is little evidence the effects of policies and institutions depend on the initial level of development of States.

Dias and Tebaldi (2012) built a model in which the role of institutions on economic growth is shaped by microeconomic foundations. Thus, the authors seek to discuss the relationship between institutions, human capital and economic growth. The authors have established the connection between institutions and human capital and observed the behavior of these variables on economic growth, assuming the fact that the improvement in the quality of institutions makes the economic growth faster, reduces income disparity and changes the development of historical path. They also considered that the accumulation of capital follows an endogenous process. The data used in the work, to test the propositions of the model, captures the period from 1965 to 2005 and were collected from Barro and Lee studies (2010); Penn World Table 6.3 and Polity IV Project, whose sample includes a total of 61 countries.

The methodology Dias and Tebaldi (2012) applied the GMM method with dynamic panels, aiming to capture the heterogeneity and the endogeneity of the data, because the differences between the countries could be captured through time. Two institutional variables were used, the first was called Structural Institution and it was measured by the ratio of people with post-secondary education and non-educated people (that is, ratio between educated and non-educated); the second, the Policy Institution Index, was the measure of democracy and autocracy removed from the Polity IV.

The authors concluded that structural institutions affect the performance of long-term growth. The political institutions were not correlated with productivity and long-term growth. Thus, structural institutions should be improved in order to contribute to this growth. The biggest implication for economic policy is that the path of growth is subjected to structural institutions, that is, the improvement of the educational process. Thus, the authors argue that in poor institutions, the process of knowledge among educated and non-educated people will be affected via lower rate of education return, which generates a smaller accumulation process and affects the long-term growth performance. That way, the best institutions will reflect immediately in better knowledge creation, by increasing the rate of education return. The acceleration of human capital growth rate generates improvements in the structural institutions.

Still in the institutional context, Aisen and Veiga (2013) estimated the effect of political instability on economic growth. Using a series of 169 countries with data from 5 to 5 years, from 1960 to 2004, the authors applied the econometric technique Systemn GMM and found an inverse relationship between political instability and economic growth. When investigating the transmission channels of political instability, they found that it affects productivity growth as well as accumulation of physical and human capital. It was found a positive relationship between economic freedom, ethnic homogeneity and economic growth. By observing the impact of democracy on economic growth, the authors found a small, negative effect.

This way, as presented in this brief review, the institutions are important in determining the growth, however, in many cases, its impact is seen through the role they play on the accumulation of physical and human capital. From this perspective, this study aims to verify how this process occurs, whether directly, indirectly or both ways.

3 Theoretical model

The theoretical model to be developed in this work follows the proposal of Dias and Tebaldi (2012), in which it is emphasized the importance of the educational sector in the economy. Following the models of Uzawa (1965) and Lucas (1988) the authors have created a human capital accumulation function, based on the following assumptions:

i) The population N increases at a constant rate n;

ii) The population is divided into: educated (h) and non-educated (n), so that N = n + h;

iii) There are two sectors in the economy: of final goods and education.

An important consideration in this model is that the final goods sector demand work from the educated and from the non-educated, which are paid according to their marginal product. Because of this fact, the educated workers have higher income because they are more productive and it creates incentive so the non-educated seek to invest in education in order to obtain higher wages. The main contribution of this model is the addition of the education sector as an aggregate income generator.

The derivation of the model may be expressed for Goods Sectors, Educational Sector and the decision to accumulate human capital, and the overall balance, as follows: [1]

The goods production function depends on the educated and non-educated work

$$y(g)=A(an)^{(1-\beta)}\ (ah)^{\beta}=aAn^{(1-\beta)}\ h^{\beta} \qquad (1)$$

In which: is the final product; is the non-educated workforce; is the educated workforce and is the technology dimension.

The real wages of educated employees working in the final goods sector is: $w_h^g = (W_h^g/AP)$, in which denotes the nominal wage of the educated and P the price level.

1 For a more detailed description see Dias and Tebaldi (2012).

The firm's profit function is given by:

$$\pi = an^{(1-\beta)} h^{\beta} - w_h^g h - w_n^g n \quad (2)$$

Note that w_h and w_n is the actual real wage of the educated and non-educated people.

Considering technological level A is given, we have the following wage equation:

$$w_h^g = \beta an^{(1-\beta)} h^{(\beta-1)} \quad (3)$$

$$w_n^g = (1-\beta)an^{(-\beta)} h^{\beta} \quad (4)$$

So that the income is distributed between educated and non-educated.

$$\left(\frac{w_h}{w_n}\right) = \left(\frac{\beta}{1-\beta}\right)\frac{n}{h} \quad (5)$$

According to the authors' interpretation, equation (5) shows that when workers go from being "uneducated" to "educated", there is a continuous reduction in the wage rate.

For the Education Sector, Dias and Tebaldi (2012) assume that the non-educated workers can be trained and receive knowledge of educated workers. The production function of this sector is given by:

$$y(e) = \gamma[(1-a)n]^{(1-\beta)} [(1-a)h]^{\beta} \quad (6)$$

In which: $0 \leq \gamma \leq 1$ measures the quality of institutions, in a way that the higher γ, the better the institutions will be.

Combining equations (6) to (1), it is obtained:

$$y(e) = \gamma \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{y(g)}{A}\right) \quad (7)$$

This implies that the technological advance makes the process of creation of human capital more complex, since a larger amount of product is required for creating increased human capital.

The model also assumes that $w_h^e = y(e)/h$, that is, the return on human capital is employed in the education sector is the average actual cost of producing human capital, this also implies an important role in the quality of institutions in determining the social return.

Dias and Tebaldi (2012) also consider that there is perfect mobility between sectors, so that workers can move from the goods sector to the education and from the education to the goods sector. Using this condition, along with the equation (3), it comes to equation (8):

$$\alpha = \frac{\gamma}{(\gamma+\beta)} \quad (8)$$

Substituting equation (6) in (7), it is obtained:

$$y(e) = \left(\frac{\gamma\,\beta}{\gamma+\beta}\right)^{n1-\beta} h^{\beta} \quad (9)$$

This equation implies that improvements in the quality of the institutions increase productivity of inputs allocated to the education sector, that is, $(\partial y(e)/\partial y) > 0$

The Dias and Tebaldi (2012) model develops the relationship between the individual decision to accumulate human capital and market conditions. The representative agent decides whether or not to invest in human capital and that decision depends on the costs incurred in the investment of this capital and the expected return flows, that is, the earnings expectations in the future.

$$W = \int_t^{\infty} w_h^g \; e^{-\left(\frac{r}{\gamma}\right)(s-t)} \, ds = \int_t^{\infty} \left(\frac{\gamma\beta}{\gamma+\beta}\right) n^{1-\beta} h^{\beta-1} \, e^{-\left(\frac{r}{\gamma}\right)(s-t)} ds \quad (10)$$

In this equation, *r/y* is the market rate of return; is the effective discount, adjusted for institutional inefficiency created by the poor institutional arrangements. As *r/y* is the investment in education, its inverse can be interpreted as the effective return rate of education.

The opportunity cost required so *n* becomes *h* is also affected by time *(t-T)*. Considering the costs are updated over time, the rate *φ*, then:

$$C = \int_T^t \left[\left(\frac{\gamma}{\gamma+\beta}\right)(1-\beta)\, n^{-\beta} h^{\beta} + \left(\frac{\gamma\beta}{\gamma+\beta}\right) n^{-\beta} h^{\beta}\right] x\, e^{\varphi(s-t)} \, ds = \int_T^t \left[\left(\frac{\gamma}{\gamma+\beta}\right) n^{-\beta} h^{\beta}\right] e^{\varphi(s-t)} \, ds = \quad (11)$$

The individual will choose to accumulate human capital if the future flow of discounted return is > or = to the cost of human capital accumulation. Assuming that at the verge, non- educated individuals will choose to acquire skills to become educated, then:

$$\int_T^{\infty} \left(\frac{\gamma\beta}{\gamma+\beta}\right) n^{1-\beta} h^{\beta-1} e^{-\left(\frac{r}{\gamma}\right)(s-t)} \, ds = \int_T^{t} \left[\left(\frac{\gamma}{\gamma+\beta}\right) n^{-\beta} h^{\beta}\right] e^{\varphi(s-t)} \, ds \quad (12)$$

I

Integrating both sides of equation in relation to *s* assuming that T→-∞

$$\frac{n}{h} = \left(\frac{\varphi\beta y}{r}\right) \quad (13)$$

This equation suggests that there is a great reason for educated and non-educated labor, in the economy, and it depends on the quality of institutions *y*, the share of human capital in the economy (β) and the discount rate assigned to the cost and capital return rate (φ,*r*).

Good institutions are associated with the ratio among educated and non-educated labor, in other words, the larger educated population in the economy.

Substituting equation (3) to (6), it is produced

$$\left(\frac{w_h}{w_n}\right) = \left(\frac{\beta}{1-\beta}\right) \frac{r}{\varphi\beta y} \quad (14)$$

Equation (14) shows that the improvement in institutions reduces the wage rate and income inequality between educated and non-educated.

$$\dot{h} = y(e) = \left(\frac{(\gamma\beta)^{\beta}}{\gamma+\beta}\right)\left(\frac{r}{\emptyset}\right)^{1-\beta} h \quad (15)$$

This is a process of endogenous accumulation of human capital, which depends on the quality of institutions, unlike Lucas (1988), whose accumulation of human capital was given by .

Continuing the analysis, Dias and Tebaldi (2012) present the overall balance of the proposed model. In the total product the economy is obtained by adding the equations (1) and (6).

$$Y = \gamma(g)+y(e) = \omega\,(\beta + A)h, \quad \text{In which } \omega = \left(\frac{\gamma^{\beta}\beta^{\beta-1}}{\gamma+\beta}\right)(r/\phi)^{-1-\beta} \quad (16)$$

By dividing equation (16) by N, the product per person it is obtained .

$$y = \frac{Y}{N} = \omega\,(\beta + A)v, \quad (17)$$

This equation is linear, for the educated labor and technology, and not linear, for institutions.

The well being function of the representative consumer is:

$$u(c) = \int_0^t \frac{c^{1-\sigma} - 1}{1-\sigma} e^{-pt} dt \quad for\ \sigma \neq 1, \quad (18)$$

Since *c* denotes the *per capita* consumption.

The technology follows the idea of Solow (1962) and, simplifying, let's consider that it is linearly related to the physical capital in the economy, such that:

$$A = \tau k, \quad (19)$$

And $\dot{k} = [\omega(\beta+\tau k)v - c - \eta k]$, in which represents the physical capital *per capita*.

The Hamiltonian function of the problem is:

$$H = \frac{c^{1-\sigma} - 1}{1-\sigma} + \lambda\,[\omega(\beta+\tau k)\, v - c - \eta k] \quad (20)$$

The solution to the problem in which *c* is a choice variable and *k* a state variable is:

$$c^{(-\sigma)} = \lambda \quad (21)$$

$$\frac{\dot{\lambda}}{\lambda} - \rho = -(\varpi\tau v - \eta). \quad (22)$$

Deriving (21) and combining with (22), it is obtained:

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}\ (\varpi\tau v - \eta - \rho) \quad (23)$$

In the way of balanced growth, GDP *per capita* and *per capita* consumption are expected to grow at the same rate. This condition implies that:

$$g_y = \frac{\dot{y}}{y} = \frac{\dot{c}}{c} = \frac{1}{\sigma}\,(\varpi\tau v - \eta - \rho). \quad (24)$$

In the balanced growth pathway, GDP *per capita* depends on the institutions, on the intertemporal discount rate and the human capital share in the economy.

For Dias and Tebaldi (2012), institutions affect the product in two ways. The first, in determining the return on human capital in the economy and the second, in a deeper way, because it determines

the optimal ratio of human capital in the economy equation 13.

4 Data and Econometric Model

4.1 Data

The goal is to test the equations (13), which establish the ratio between educated and non-educated about the stock of human capital in the economy, and the equation (24), which looks at the impact of institutions and accumulation of physical and human capital on the long-term economic growth in Brazil. In addition to the structural institutions, the trial also discusses the political institutions, whose goal is to observe the impact of political performance on human capital and growth in Brazil.

It is intended, therefore, to analyze how the institutions explain the accumulation of human capital and then through the use of other control variables, observe how the accumulation of human capital explains the growth of GDP *per capita*. This way, it is possible to estimate the effects of institutions on economic growth, through the accumulation of human capital.

In order to test the model prepositions, a set of panels will be used for Brazilian States, with data from 2002-2008[2] with a year by year gap, and the variables that represent the physical and human capital were obtained as follows:

Physical capital:

Following the proposal of Garafolo and Yamarik (2002), it was built up the stock of private physical capital of Brazilian states.

$$k_{g,j(t)}=K_{i,j}(t) + k_{m,j}(t) \quad (25)$$

Em que:

$k_{g,j}(t)$=Private gross physical capital stock- by state;

$K_{i,j}(t)$=Private gross physical capital stock (construction) – by state;

$k_{m,j}(t)$=Private gross physical capital stock (machinery and equipment) – by state.

Human capital:

The human capital was built through the following equation:

$$h_{it} = \exp(\alpha E_{it}-\beta E_{it}^{2}+ +\delta E_{it}^{3}+y ex_{it}- \delta E_{it}^{2}) \quad (26)$$

In which:

E_{it} =Average years of schooling state at time ;

ex_{it}=Experience[3] (per employee) in the state in the period .

In the construction of this stock, it was used the Heckman correction (1979) and a selection equation in order to improve the robustness of the estimates. After the construction of individual stocks, we calculated the average stock of human capital by state, those averages were applied to the dynamic estimates.

Structural institution

The structural institution variable followed the proposal of Dias and Tebaldi (2012): by educated and non-educated reason.

Structural institution : higher education/no education

The calculation of this variable was done through the National Household Survey (PNAD) and considered people above 25 years old.

Political institution

In addition to the structural institution, this article also seeks to use an indicator that links economic growth with political institutions. Since in Brazil there is no specific variable to this case, it was worked a *proxy* created by Buzzo (2014), used as an Institution Policy indicator.

This *proxy* was based on na article by Afonso et al. (2005), which built indicators to analyze the performance of the public sector (PSP) and the efficiency of this sector (PSE). This construction occurred through seven subindicators, which include legal aspects, infrastructure, services in education and health, government contribution to the distributive issue, resource allocation and stability of the economic system. In this study, in order to avoid multicollinearity problem, inflation and

2 The database was until the year 2008 because the variable stock of physical capital to Brazil, provided by IPEA was used.

3 The experience definition is given by the average age of all employees, less the average years of schooling, less six years.

GDP in the computation of performance indicator were taken off.

The performance indicator of the public sector (PSP) is an aggregate of the above subindicators, and the public-sector efficiency indicator is the ratio of (PSP) and the statement of expenditure on investment and transfers from the public sector, in the period (PEX), that way:

$$PSP_i = \sum_{j=1}^{n} PSP_{ij} \quad (28)$$

$$PEX_i = \left(\frac{G_i}{Y_i}\right) \quad (29)$$

Computing (PSP) and (PEX), it becomes possible to make the efficiency indicator (PES)

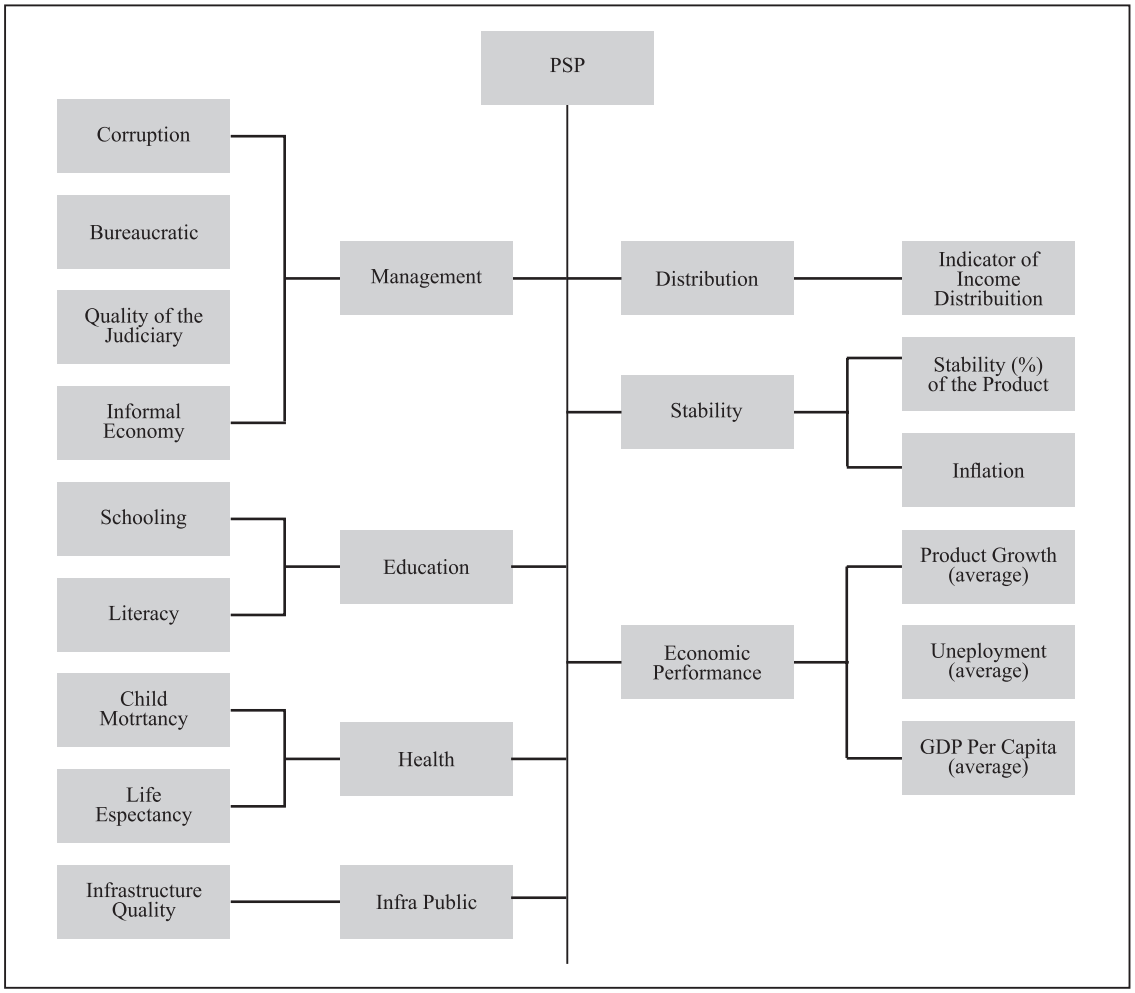
$$PSE_i = \frac{PSP_i}{PEX_i}, \quad (29)$$

$$\frac{PSP_i}{PEX_i} \sum_{j=1}^{n} \frac{PSP_{ij}}{PEX_{ij}} \quad (30)$$

The abstract for the construction of these indicators can be better understood in the Box 1, as Afonso et al. (2005) cited Buzzo (2014).

In calculating these indicators for Brazil, Buzzo (2014) made some modifications due to the availability of data. The first change made by the author refers to the time section, in which used with a strongly balanced data panel, that is, without gaps, unlike Afonso et al. (2005), who worked with average. The author built these indicators for the years of 1998-2009, using data collected from the National Household Survey (PNAD), SMEs and IPEADATA.

Box 1 - Total composition of the performance indicator of the public setor (PSP)



Source: Afonso et al. (2005)

4.2 Econometric Model

The specification of the model can be seen as follows:

$$y_{it} = x_{it}\beta + y_{it-1}\alpha + n_i + \delta_t + u_{it} \quad (31)$$

y_{it} is the dependent variable, in this case, at first, it will be human capital and then the growth rate of per capita product; x_{it} is the vector of explanatory variables, represented by different definitions of institutions, physical capital and human capital; β is the vector of coefficients which will be calculated; n_i are the specific components of each country; are δ_t specifics effects of the time; and u_{it} is the vector of errors.

Under contemporary exogeneity, errors can not be correlated to predetermined variables, as follows: $E(u_{it}| x_{it}, y_{it-1},...,x_{i1}, y_{i0}, n_i)=0$. This equals to the performance of two tests:

1) In the regressive process of second order, panel residues should be zero, that is:

$E(u_{it} |u_{it-1}),...,u\_i1)=0$

2) The instrumental variable must be exogenous, that is: $E\,(u_{it}\,|\,x_{it}\,,\ldots\,)\,x_{i1}\,)=0$.

These conditions depend on the quality of the instruments. In order to acquire better tools, the dynamic specification can be estimated on a system of equations:

$$y_{it} - y_{it-1} = (x_{it} - x_{it-1})\beta + (y_{it-1} - y_{it-2})\,\alpha + (u_{it} - u_{it-1}) \quad (32)$$

One of the problems of dynamic estimates, using the method of Ordinary Least Squares (OLS), is that the gap (lag) of the dependent variable can be correlated with the error term, which creates bias in the sample, making inconsistent estimates.

The solution to the problem was pointed out by Arellano and Bond (1991), which created the estimator of the Generalized Method of Moments (GMM), whose practical suggestion is to equip the explanatory variables in differences, which are not strictly exogenous, with their lags available level. Thus, in this first difference GMM estimator, lags in available level may be weak instruments for variables not strictly exogenous if these gaps can be characterized as a random walk.

Continuing this correction, Arellano and Bover (1995) and Blundell and Bond (1998) developed the GMM System, which is associated to the addition of the GMM in difference, to the original equation level (33), increasing efficiency due to presence of more instruments, being that, in the equation in difference, the variables in difference are manipulated with their lags available in levels, whereas in the equation in level, the variables in level are instrumented with appropriate time lags its own first differences.

Cangusso et al. (2010) score that these estimators are suitable in the use of panel data when it has: i) short periods of time and many individuals; ii) linear functional relationship; iii) dependent variable with autoregressive coefficient; iv) explanatory variables not strictly exogenous; v) fixed effects for individuals and vi) the heteroskedasticity and autocorrelation within groups of individuals but not between the groups.

Thus, the Arellano-Bond estimator (1991) uses the variables in difference and the generalized method of Hansen (1982) moments, to estimate the parameters, so it is known as "difference GMM". The Arellano-Bover/Blundell-Bond estimator is equivalent to the Arellano-Bond estimator, including an additional hypothesis: the first difference of the instruments is not correlated with the fixed effects, which can increase the number of instruments and gain in efficiency. This second estimator which combines the first-difference equations with the equation levels is known as "GMM system".

2 Results and discussion

The empirical results presented in this work were selected based on results of Arellano-Bond tests (1991), AR (1) and AR (2), in the first difference, in the Sargan tests that validate the restrictions of models and the Difference-in-Hansen exogeneity test. The following discussion relates to the models calculated using the GMM estimator with robust covariance matrix[4].

Table 1 shows the estimated impact of institutions and human capital lag on the current human capital. Three models are presented, one without

4 The Sargan Test overidentification is robust to the number of instrument used to estimate the model, especially when the number of instruments are larger than the number of groups. When the number of instruments are smaller then the number of groups, it is reported the Sargan and tha Hansen Overidentification tests.

any control, that is, with only the explanatory variables, the second considers the time dummies and eventually the complete model, where the time and region dummies are used.

The first conclusion that can be drawn from the estimates, is that, when controlled by the institution, the constant term is not significant at any level of significance. It is observed also that the stock of human capital suffers strong influence of the past, meaning, the lags of the variables were significant in all three models presented and the complete model, accounts for approximately 75% of current human capital. When it comes to institutional variable, it is observed that it has a negative impact on human capital, but only in the model which are not considered the time dummies and region. In the full model, it is observed that the value of the coefficient is higher and highly significant. The test results of the autoregressive process of order 1 and 2 as well as Sargan test that examine the validity of restrictions also were consistent for the proposed model.

Thus, the results are statistically significant and show themselves favorable to the acceptance of equation (13), in which the best institutions generate higher level of human capital in the economy. These estimates confirm the hypothesis raised by Dias et al. (2012), which show through the microeconomic foundations, that institutions can affect economic growth through its impact on the level of human capital in the economy.

Table 1 - Institution of Structural impact on the human capital level

Variables	(1) he	(2) he	(3) he
L. Human capital in level	0.895***	0.954***	0.747***
	(0.0483)	(0.0377)	(0.227)
Structural intitution	-0.0582***	0.0223**	0.0297***
	(0.0188)	(0.0101)	(0.00850)
Constant	0.610***	-0.144	-1.079
	(0.227)	(0.196)	(5.628)
Time Dummie	NO	YES	YES
Region Dummie	NO	NO	YES
Observations	189	189	189
Order number	27	27	27
AR(1)	-1.6532	-1.6637	-1.8812
Prob > z	(0.0983)	(0.0962)	(0.0600)
AR(2)	0.5992	0.97539	1.0277
Prob > z	(0.5490)	(0.3294)	(0.3041)
Sargan test	25.81926	22.70544	19.97603
Prob > chi2	(0.4731)	(0.6496)	(0.5845)
Hansen difference exogeneity test	0.339	0.799	0.881

OBS: N= n*T number of observations; AR(1) and AR(2) are the results of the tests of the autoregressive process of order 1 and 2, respectively. The Sargan test examines the validity of the restrictions. Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1.

Table 2 discusses the role of political institutions on human capital level in Brazil. In this approach, the validity of the restrictions of first and second order autocorrelation tests were only significant in the first model, when time and region was not controled. The result of this analysis shows that the Political Institutions are important in explaining the level of human capital, but this impact is only found in the second lag period, it shows that it takes some time to observe changes in the political performance in human capital. In general, it can be assumed, from this specification, that states with better performances tend to be more efficient and thereby increase the stock of human capital. The results also indicate that the level of human capital, from the previous period, has strong influence on the current human capital, a consistent result with those found in Table 1, his way it is possible to detect that a good part of the current human capital is explained by its previous result, mainly when there are tracking of time and region. It is worth mentioning that this empirical test is little explored in the literature since the majority of studies seek to verify the impact of institutions on economic growth and not on the level of human capital. The most well-known results for this analysis are of theoretical characteristics such as the one presented by Dias and Tebaldi (2012).

Table 2 - Impact of Political Institutions on the human capital level

Variables	(1) he	(2) he	(3) he
L. Human capital in level	0.337***	0.836***	0.816***
	(0.0264)	(0.0590)	(0.102)
Political institution	-0.0478	0.138**	0.0245
	(0.0510)	(0.0568)	(0.148)
L. Political institution	0.0166	0.513***	0.270
	(0.0794)	(0.113)	(0.331)
L2. Political institution	0.826***	0.169**	0.264*
	(0.101)	(0.0841)	(0.148)
Constant	-0.896***	-0.360	0.0572
	(0.175)	(0.336)	(0.947)
Time Dummie	NO	YES	YES
Region Dummie	NO	NO	YES
Observations	162	162	162
Order number	27	27	27
AR(1)	-2.170	-1.542	17.184
Prob > z	(0.0300)	(0.1229)	(0.9927)
AR(2)	-1.057	0.4998	-1.5704
Prob > z	(0.2905)	(0.6172)	(0.1163)
Sargan test	25.14001	19.593	0.66776
Prob > chi2	(0.9308)	(0.9941)	(0.5043)
Hansen difference exogeneity test	0.404	0.889	0.901

OBS: N= n*T number of observations; AR(1) and AR(2) are the results of the tests of the autoregressive process of order 1 and 2, respectively. The Sargan test examines the validity of the restrictions. Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1.

Estimates of the impact of institutions on economic growth is shown in Table 3. The variables used in the model are: human capital, stock growth rate of physical capital and structural institution.

The results also show that structural institutions affect the long-term growth of the Brazilian economy. In the models 1 and 3, it is seen that the coefficients of the first lag of structural institutions are positive and statistically significant. Emphasized that contemporary coefficient of the institution variable was not significant, a result that confirms the idea that the structural institutions affect growth, but its impacts are felt only in the long term, these results already outlined by Tebaldi and Elmslie (2013), Hall and Jones (1999), Acemoglou et al. (2005b), among others.

These results suggest strong evidence that the growth rate of physical capital per worker has an impact on the product growth rate. Comparing these results with those of Dias et al. (2012), which was tested for a series of countries, it is observed that the value of the coefficient found for Brazil was similar to the authors' results, however, here the lag variable of physical capital was not significant on the growth of the product, whereas the results of the authors, this coefficient is negative and significant. These results corroborate also those attested by results of Acemoglu et al (2005; 2005b); Knack et al. (1995) by empirically showing that institutions can affect economic growth with a direct impact on economic growth.

Table 4 shows the impact of political institutions, human capital and physical capital to the GDP growth *per capita* in Brazil.

Table 3 - Impact of structural Institution on the growth rate of GDP *per capita*

Variables	(1)	(2)	(3)
	gpibpc	gpibpc	gpibpc
L. growth rate of GDP pc	-0.188**	-0.225**	-0.216**
	(0.0882)	(0.0891)	(0.0872)
L2. growth rate of GDP pc	-0.150	-0.133	-0.111
	(0.102)	(0.0837)	(0.0860)
Human capital in level	0.134***	0.0297	0.0360
	(0.0233)	(0.0337)	(0.0349)
L. Human capital in level	-0.125**	-0.0792**	-0.0733*
	(0.0571)	(0.0377)	(0.0399)
L2. Human capital in level	0.00614	0.0642	0.0537
	(0.0607)	(0.0613)	(0.0612)
Growth rate of physical capital per worker	0.0743**	0.0755**	0.0762**
	(0.0355)	(0.0314)	(0.0315)
L. Growth rate of physical capital per worker	0.0430	0.0391	0.0412
	(0.0262)	(0.0254)	(0.0258)
Structural institution	-0.00526*	0.00288	0.00289
	(0.00271)	(0.00343)	(0.00376)
L. Structural institution	0.0211***	0.0147	0.0169**
	(0.00772)	(0.00906)	(0.00835)
L2. Structural institution	0.00676	0.000524	0.00543
	(0.00590)	(0.00571)	(0.00663)
Constant	-0.105	-0.0659	-0.0667
	(0.0796)	(0.0739)	(0.114)
Time Dummie	NO	YES	YES
Region Dummie	NO	NO	YES
Observations	135	135	135
Order number	27	27	27
AR(1)	-3.3032	-3.3132	-3.3823
Prob > z	(0.0010)	(0.0009)	(0.0007)
AR(2)	-0.43668	-0.69196	-0.79654
Prob > z	(0.6623)	(0.4890)	(0.4257)
Teste Sargan	18.37657	16.61238	12.92858
Prob > chi2	(0.4974)	(0.6161)	(0.6078)
Hansen difference exogeneity test	0.445	0.445	0.889

OBS: N= n*T number of observations; AR(1) and AR(2) are the results of the tests of the autoregressive process of order 1 and 2, respectively. The Sargan test examines the validity of the restrictions. Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1.

In accordance with the presented results, when considering the structural institutions, the models indicate the existence of convergence of income among Brazilian states. This indication occurs through negative impact of the GDP gap over the GDP growth rate *per capita*. Human capital continues to positively influence economic growth, being essential its inclusion in the study of economic growth in Brazil, as pointed out by Nakabashi (2005), Dias and Dias (2010). Like Aisen and Veiga (2013) these results show that better political institutions can contribute positively to economic growth.

In models that were considered time and region control, it was possible to observe that political institutions matter for growth in GDP *per capita* and its positive impact, meaning, the better the government performance, most favored the growth will be, a result that is supported in theoretical studies.

It is important to observe that, unlike the structural institutions, which affected growth only after a lag period, political institutions generate more immediate impact on the economic system, and is therefore, a source of government policy achievement.

Table 4 - Policy Institution impact on GDP growth rate *per capita*

Variables	(1)	(2)	(3)
	gpibpc	gpibpc	gpibpc
L. Growth rate of GDP *per capita*	-0.211**	-0.328***	-0.331**
	(0.103)	(0.0816)	(0.141)
L2. Growth rate of GDP *per capita*	-0.170***	-0.165***	-0.324***
	(0.0458)	(0.0584)	(0.109)
L. Human capital in level	0.129***	0.0606***	0.0877***
	(0.0155)	(0.0178)	(0.0219)
L2. Human capital in level	-0.125***	-0.0632***	-0.0813***
	(0.00996)	(0.0186)	(0.0196)
Growth rate of physical capital	0.0178	0.0208	0.0203
	(0.0161)	(0.0170)	(0.0201)
Political Institution	-0.0349	0.0873**	0.101*
	(0.0375)	(0.0403)	(0.0554)
L. Political Institution	-0.0404	-0.0457	-0.0572
	(0.0940)	(0.0572)	(0.0833)
Constant	0.0791	0.0130	0.0431
	(0.141)	(0.0506)	(0.113)
Time Dummie	NO	YES	YES
Region Dummie	NO	NO	YES
Observations	135	135	135
Order number	27	27	27
AR(1)	-2.5936	-2.7548	-2.9157
Prob > z	(0.0095)	(0.0059)	(0.0035)
AR(2)	-1.1093	-0.77826	0.02662
Prob > z	(0.2673)	(0.4364)	(0.9788)
Teste Sargan	24.04713	19.01432	11.33038
Prob > chi2	(0.8974)	(0.9822)	(0.9992)
Hansen difference exogeneity test	0.445 0.445	0.789	0.992

OBS: N= n*T number of observations; AR(1) and AR(2) are the results of the tests of the autoregressive process of order 1 and 2, respectively. The Sargan test examines the validity of the restrictions. Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1.

3 Final considerations

The theoretical and empirical model presented in this work, showed the importance of the interaction of physical capital, human capital and institutions in explaining the long-term economic growth process in Brazil. It was observed that the structural institutions and policy play an important role in this process inasmuch as they contribute to the higher dynamism of the technological process of the country as well as to improve the economic performance. Productivity can contribute to a better return on human capital in the economy and this can induce non-educated to become educated people, as the highest return causes people to desire improving their knowledge. The results are consistent with the theoretical proposal advocated in this research, that is, institutions help to explain the long-term economic growth process in Brazil.

Finally, the trial has an innovative approach of long-term dynamics of institutions for Brazil, as well as contributes to a new approach in the definition of physical and human capital. As subsequent proposals, it is intended to define new institutional variables and observe its impact on the long-term growth, in Brazil.

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