Resumo: Este artigo visa contribuir para o debate econômico sobre a relação entre desenvolvimento financeiro e crescimento econômico numa perspectiva de desenvolvimento regional. Esta pesquisa examina empiricamente a relação entre crescimento econômico e desenvolvimento financeiro com base nas Unidades Federativas do Brasil, no período de 2006 a 2017. Do ponto de vista metodológico, utiliza-se modelos econômicos para dados em painel que possibilitem mostrar os efeitos dos indicadores de desenvolvimento financeiro sobre PIB real. No que tange a avaliação por Estados, os resultados empíricos mostram uma relação positiva entre o desenvolvimento do sistema financeiro e o crescimento econômico. Mais especificamente, os resultados mostram que indicadores econômicos e financeiros como “abertura econômica”, “depósitos a prazo” e “depósitos à vista”, além de indicadores fiscais como gastos correntes, afetam positivamente o PIB real. Por fim, os resultados empíricos por região são similares aos resultados por unidades da federação.


ECONOMIC GROWTH AND FINANCIAL DEVELOPMENT - A REGIONAL ANALYSIS

Abstract: This paper aims to contribute to the economic debate on the relationship between financial development and economic growth from a regional development perspective. This research empirically examines the relationship between economic growth and financial development based on the Federative Units of Brazil, from 2006 to 2017. From a methodological standpoint, it uses econometric models for panel data that allow showing the effects of financial development indicators on real GDP. Regarding the evaluation by States, the empirical results show a positive relationship between financial system development and economic growth. More specifically, the results show that economic and financial indicators such as “economic openness”, “savings deposits” and “checking deposits”, as well as fiscal indicators such as current expenditures, affect positively real GDP. Finally, the empirical results for regions are similar to the results for units of the federation.

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2006 to 2017. From a methodological point of view, we use econometric models for panel data that make it possible to show the effects of financial development indicators on real GDP. Regarding the assessment by States, the empirical results show a positive relationship between the development of the financial system and economic growth. More specifically, the results show that economic and financial indicators such as “economic openness”, “term deposits” and “demand deposits”, as well as fiscal indicators such as current expenditures, positively affect real GDP. Finally, the empirical results by region are similar to the results by federation units.

Keywords: Panel data, Real GDP, Economic openness, financial indicators, States of the Federation.

CRECIMIENTO ECONÓMICO Y DESARROLLO FINANCIERO - UN ANÁLISIS REGIONAL

Resumen: Este artículo pretende contribuir al debate económico sobre la relación entre desarrollo financiero y crecimiento económico desde una perspectiva de desarrollo regional. Esta investigación examina empíricamente la relación entre el crecimiento económico y el desarrollo financiero con base en las Unidades Federativas de Brasil, de 2006 a 2017. Desde un punto de vista metodológico, utilizamos modelos econométricos para datos de panel que permiten mostrar los efectos de los indicadores de desarrollo financiero en los PIB real. En cuanto a la valoración por Estados, los resultados empíricos muestran una relación positiva entre el desarrollo del sistema financiero y el crecimiento económico. Más específicamente, los resultados muestran que indicadores económicos y financieros como la “apertura económica”, los “depósitos a plazo” y los “depósitos a la vista”, así como indicadores fiscales como los gastos corrientes, afectan positivamente al PIB real. Finalmente, los resultados empíricos por región son similares a los resultados por unidades de la federación.

Palabras clave: Datos de panel, PIB real, Apertura económica, indicadores financieros, Estados de la Federación.

Does the development of the financial system imply economic growth? The question brought by this article is necessary because, in recent years, researchers worldwide have started developing important scientific studies on the role of the financial market in promoting economic growth. In the global context, there is a latent difference between rich and poor countries in the global economic situation, where they grow at different rates. In the global scenario, the most developed countries, in general, also have their financial markets developed.

The Financial System is analyzed in this study from a contemporary global perspective, based on modern concepts situated from the dismantling of the Bretton Woods Agreement in the 1970s. In this context, Bretton Woods Conference aimed to establish a balance between the monetary policies of post-war countries, to maintain parity with national currencies on the dollar-gold standard. From the 1980s onwards, the academic agenda began to be taken by the need to seek models that synthesize the drivers of economic growth. In this eagerness to seek options to clarify the Solow Residual, studies on the development of the financial system and its relationship with economic growth have become a topic of high relevance in socio-economic research agendas. In a didactic way, economic growth concerns the increase in the aggregate product of the country, which is manifested by the continuous increase in its GDP (Gross Domestic Product). Such growth may occur in the short or long terms. In the short term, through household consumption, easier credit, and increased government spending, it will boost the economy. In the long term, through more lasting measures based on factors of production.
Practically, the financial system is formed by surplus agents, represented by the financial institutions that offer credit in the economy, and by deficit agents or demanders. In this context, it should be noted that the primary purpose of the financial system is to transfer resources held by investors to the productive sector or the consumer sector, generating, in theory, a multiplier effect on the economy. The degree of development of the financial sector necessarily depends on the historical context, degree of openness, and regulation of each country. In this sense, it is worth noting that aspects of financial intermediation to finance economic growth were already a topic explored by Schumpeter in the first decade of the 20th century, and Keynes after the crisis of 1929. However, national studies (the Brazilian case) are scarce and distant when compared to analyzes at an international level. In this sense, this study was idealized and developed because of the motivation in seeking data for the construction of analyzes through the Federative Units of Brazil.

The first studies linking economic growth and financial development were conducted using cross-country analysis to study the relationship between these variables. This point can be seen in the studies of King and Levine (1993) and Goldsmith (1969). Still concerning the introduction of the theme, in a more contemporary way, it is noticed that there needs to be a consensus on the relationship between financial development and economic growth in the literature. Nevertheless, there is a greater effort regarding exploring the theme, based on central discussions by Levine (1997), in the sense of expanding analyses from the 90s onwards. However, it was already explored more classically by Schumpeter (1911) in an essay that portrays economic development in the vision of Joseph Schumpeter. There are conflicting observations about the financial system’s role in economic growth. In this sense, we can cite Levine (1997), who works in a line of economic efficiency, where financial intermediaries act by connecting investors and borrowers. The more efficient they are, the more growth they tend to provide in allocating resources capital. Financial intermediation occurs when there is a relationship between surplus economic agents, known as savers, and deficit economic agents, who seek to take resources via the financial market. In another sphere, there are authors such as Lucas (1988), who claim that the role of the financial system is “timid” in this relationship since this sector is already overloaded. Other authors combine the theory of endogenous growth and the microeconomics of financial systems, especially after a new interest in growth theories because of the role of the financial system. In this line, there are prominent authors such as Romer (1986), Khan (2001), and Pagano (1993), among others.

Financial intermediaries, such as banks and other forms of intermediation, contribute to the reallocation of resources in the economy through the flow of surplus agents (savers) towards those with cash shortages. This dynamic mechanism of financial intermediation is based on the imbalance between the level of savings and investments in an economy. It will be more efficient when the interaction between savers and borrowers can promote economic growth. The study addresses the apparent relationship between financial development variables and their effects on economic activity through the Real Gross Domestic Product. To this end, based on a theoretical framework, we seek to put into practice a series of studies to find the best path for this relationship. It is noteworthy
that, for the national case, the challenge becomes greater because of the almost absence of references from the perspective of the federative units to build a nationwide analysis of the problem. Based on international cases, adjustments to the model will be made to ensure the econometric application.

This article is organized into the following five sections: In the second section, the literature review is presented based on national and international research on the subject, emphasizing the most published articles of greater academic relevance. In the third section, we describe the methodological procedures, the base collection and classification, the applied variables, and the regression model with panel data used in the research. In the fourth section, we present the empirical results. In the last section, the final stage of the study is presented, with the conclusion and indication of the main findings.

LITERATURE REVIEW

Faced with the difficulty of neoclassical models to satisfactorily explain the key points of economic development, the production of research on the subject has since moved away. However, from the middle of the second half of the 20th century, with the emergence of endogenous economic growth models inspired by the formulations of Romer (1986), the theme was taken up again with a certain impetus (MATOS, 2002). Through econometric modeling, this study seeks to emphasize the role of financial development as a driving force for economic growth. It is necessary to know the Brazilian financial system to understand its importance in the face of the flow of funds between savers and borrowers and the characteristics of the institutions that represent it. In practice, the National Financial System (SFN) is structured by a block of public and private institutions and by its highest organ, the National Monetary Council.

According to the Central Bank of Brazil, the “National Financial System (SFN) is formed by a set of entities and institutions that promote financial intermediation, that is, the meeting between savers and borrowers of resources.” In this sense, it is the role of the SFN to facilitate and regulate the relationship between borrowing and saving agents in the financial system. The National Financial System is divided into two subsystems. The first one is responsible for defining guidelines, inspecting, and applying the operating rules of the system, called the Normative Subsystem. The second one, responsible for promoting the transfer of resources between market agents, is called the Financial Intermediation Subsystem (Figure 1). This study does not intend to conceptualize the entire framework that governs the structure of the SFN but to apply the effects of this system in a concrete case, which does not remove the need to understand how all the gears and particularities of the Brazilian model work. In this sense, Figure 1 is relevant for understanding the relationship between the development of the financial system and economic growth.

About the Brazilian case, research and empirical evidence on the relationship between the development of the financial system and economic growth are still very scarce. However, they can be verified in some studies, such as Silva and Porto Junior
The model developed by Silva and Porto Junior (2006) used the Quantile Regression technique to verify the association between economic growth (as a variable of interest) and measures of financial development (as explanatory variables) in various quantiles of the conditional distribution. In this case, it was concluded that evidence of a positive relationship between financial development and economic growth was found empirically. They were corroborating that the quantified regression method applied in the study produced such a finding.

Matos (2002) used the causality test proposed by Granger for empirical verification. For this, the author has adopted a series of annual data covering the periods from 1947 to 2000, 1963 to 2000 (interval of bank credit to the private sector/GDP), and 1970 to 2000 (interval of credit from the financial system to the private sector/GDP). Thus, through the Granger causality method, the results obtained corroborate the existence of direct and unidirectional impacts of financial development on economic growth. For Marques Jr. and Porto Jr. (2004), the results found differed from those of other authors on this subject in Brazil. With the help of the technique of quantile regressions, the authors show that “the causal relationship is unequivocal in the sense that financial development causes economic growth when the indicators refer to the development of the banking system, and when the causal relationship is applied to the indicators of development of the capital market, the conclusion is contradictory” (MARQUES; PORTO JUNIOR, 2004).

The article by Missio et al. (2010) assesses the relationship between financial development and economic growth, from 1994 to 2005, for the Federative Units of Brazil. In this sense, the authors apply the quantile regression technique to evaluate the cor-

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**Figure 1: SFN division into subsystems**
Source: Brazilian Central Bank (2022).
relation between the state GDP (response) variable with the measures of development (explanatory) variables. To this end, quantile regression is used to identify the impact of financial variables on state GDP. The conclusion of the study points to a positive relationship between variables.

Similarly, and more recently, Pessoa, Braga, and Morais (2019) investigated the link between the financial development of Brazil and economic growth through a panel of data from all Brazilian states in the 1995-2014 interval, using control variables and proxies. In this case, the relationship was evaluated from the point of view of financial development indicators to capture its different aspects. The relationship is guided by flexible regression modeling. The study concludes that there is a relationship between financial development and economic growth, and the relationship between the variables is positive and non-linear. About international cases, research and empirical evidence of the relationship between the development of the financial system and economic growth are more abundant and can be found in the map below, mainly in the studies of Levine (1997); Sassi and Goaied (2013); Patrick (1966), De Gregorio et al. (1995); Arestis et al. (2001); Zhang et al. (2012); and Shahbaz et al. (2013); among others.

Figure 2: Main authors with research related to the title of this study
Source: Elaborated by the authors using the VOSviewer software.

In this sense, Levine (1997), in an article referring to the discussion of this study, researched the empirical relationship between long-term growth and financial development through the association between bank credit to the private sector and GDP. In a cross-country sample, the author found that this proxy is positively correlated with growth. However, its impact varies across countries and ends up being negative when looking at a panel of data for Latin America. The main argument is based on the statement that “the main transmission channel from financial development to growth is the efficiency, not the volume, of investment” (LEVINE, 1997). Yet, Levine (1997) points to empirical evidence of a positive, first-order relationship between financial development and economic growth. The author deduces that changes in the telecommunications sector, computers, non-financial sector policies, institutions, and economic growth themselves influence the structure and quality of financial services. In this sense, the
conclusion of the study suggests that the more efficient the financial system, the greater the relationship between financial development and economic growth.

Before 1997, King and Levine (1993) presented evidence through a trial using data from 80 countries in the period from 1960 to 1989. In an empirical study (also a reference in the economic literature), they concluded, after analyzing the strength of the relationship between the growth of long-term real GDP per capita and some indicators of the level of financial development, that there is a positive, significant result and a robust partial correlation between the average annual rate of real GDP growth per capita and the average level of the financial sector. Still, in the context of King and Levine (1993), “the conclusion is that the predetermined component of financial development is strongly correlated with future rates of economic growth, physical capital accumulation and improvements in economic efficiency.” The result corroborates the point of view of Schumpeter (1911), as in his view it is "creative destruction," where production and old goods are replaced by better methods and procedures. In this sense, new business arrangements and financing of tangible and intangible investments lead to innovation, thus reflecting economic development.

The study by Sassi and Goaied (2013) evaluated the effect of financial development and Information and Communication Technology (ICT) on economic growth. The empirical model of the study is based on the estimation of a dynamic panel model with estimators of the GMM system applied in the countries of the Middle East and North Africa regions. The study estimates reveal a positive and significant result of the direct effect of ICT proxies on economic growth. The study by Hasan et al. (2009) tested regional growth in 11 European countries, through financial development, with the inclusion of cost and profit efficiency estimates as measures of the quality of financial institutions. Contrary to the application of the usual quantitative financial development proxies, the study points out that the quality of financial institutions is measured, in this study, as the relative capacity of banks to intermediate funds. Thus, the conclusion is that the improvement in banking efficiency drives regional growth about five times more than a similar increase in credit.

Hassan et al. (2011) analyzed the role of financial development in economic growth in low-, middle-, and high-income countries ranked by the World Bank. To estimate the relationship between financial development and economic growth, they used panel and variance regressions to explain economic growth in geographic regions by income groups. However, as necessary as financial development may be, achieving a stable economic growth rate in developing countries is not sufficient. Still, in this context, Arestis et al. (2001), through time series methods, using data from five developed economies, investigated the correlation between economic growth and the development of the financial system using the stock market. The result of the study pointed out that banks have a stronger effect than stock exchanges about economic development. The authors also suggest that “the contribution of equity markets to economic growth may have been exaggerated by studies using growth regressions across countries” (ARESTIS et al. 2001).

Zhang et al. (2012) used data from 286 Chinese cities from 2001 to 2006 to investigate the relationship between financial development and economic growth, using traditional
cross-sectional regressions and GMM estimators for dynamic panel data. The conclusion
suggests that most traditional financial development indicators are positively associated with
economic growth. The article states that “the result goes against the existing assertion that a
state-controlled banking sector, such as that of China, hinders economic growth due to the
distorted nature of the government” (ZHANG, 2012). More recently, Shahbaz et al. (2013)
promoted a study on the relationship between energy use and economic growth, triggering
financial development, international trade, and capital as important factors of the production
function in the case of China in the period from 1971 to 2011. The ARDL bounds testing
approach for cointegration was applied to examine the long-term relationship between the
series. In contrast, the stationarity properties of the variables were tested by applying the
structural break test. The implications show that energy use, financial development, capital,
exports, imports, and international trade positively impact economic growth.

More recently, one can cite the study of Ruiz (2018), which analyzes the non-linear
relationship between financial development (due to institutional investors) and economic
growth. The study is based on the analysis of 116 economies obtained from the World
Bank from 1991 to 2014. In this sense, industrialized and developing economies were
analyzed through the dynamic panel threshold. The conclusion points out that countries
above the financial limit grow faster, while those below it grows less. However, the study
clarifies that institutional investors positively influence per capita GDP growth in indus-
trialized economies. Currently, the study of Asteriou et al. (2019) emphasizes the rela-
tionship between economic development and financial development from the perspective
of the recent subprime financial crisis. To this end, panel data from 26 European Union
countries was used from 1990 to 2016. The model adopted addresses two sub-periods:
before and after the crisis. The conclusion is that before the crisis, financial development
promoted economic growth. However after it, the evidence is that the financial system
hampered economic activity. In general, Calderón and Liu (2003) also addressed the
topic. They evaluated approximately 109 developing and developed countries from 1960
to 1994, seeking to explain the direction of causality between financial development and
economic growth. The study applies the Geweke decomposition test on pooled data and
concludes that “financial development generally leads to economic growth; The Granger
causality of financial development to economic growth and the Granger causality of eco-
nomic growth to financial development coexist” (CALDERÓN and LIU, 2003).

METHODOLOGY AND DATABASE

This section presents information divided into two items. At first, it is described
the variables used in the empirical models and the descriptive statistics. At second, it is
shown the aspects of empirical modeling are shown.

DESCRIPTION OF VARIABLES INSERTED IN THE MODEL

Table 1 presents the macroeconomic variables, the description of each variable and
the data source, as shown below.
Table 1: Description of variables from 2006 to 2017 (Annual data)

<table>
<thead>
<tr>
<th>Macro variables</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>State GDP at current prices in R$ (thousand), deflated by the IGPDI, as a variable to be explained.</td>
<td>Brazilian Institute of Geography and Statistics.</td>
</tr>
<tr>
<td>Openness</td>
<td>Current exports plus imports, in R$, divided by current GDP, as a characteristic variable of an open economy.</td>
<td>Ministry of Industry, Foreign Trade and Services - MDIC - EXPORT AND IMPORT</td>
</tr>
<tr>
<td>Term deposit</td>
<td>Term deposits in R$, at 2010 prices (thousand). It is used to produce a multiplier effect on the economy. Variable of the development of the financial system.</td>
<td>Brazilian central bank (BCB) - DEPOSITPRA</td>
</tr>
<tr>
<td>Demand deposit</td>
<td>Demand bank deposits in R$, at 2010 prices (thousand). It is used because it has a multiplier effect on the economy. Variable of the development of the financial system.</td>
<td>Brazilian central bank (BCB) - DEPOSITAV</td>
</tr>
<tr>
<td>Actual current expense</td>
<td>Current State Expenditure in R$. Used at work due to its multiplier effect on the economy. These are government expenditures deflated by the IGP-DI.</td>
<td>Ministry of Finance - National Treasury Secretariat - DESPCORRE.</td>
</tr>
<tr>
<td>Actual capital expenditure</td>
<td>Capital Expenses in R$. An indicator that lists State investments. These are government expenditures deflated by the IGP-DI.</td>
<td>Brazilian Institute of Geography and Statistics</td>
</tr>
</tbody>
</table>

Source: elaborated by the authors.

It is important to clarify that the Openness variable is used in study to measure the level of openness of the Brazilian economy from the perspective of the twenty-seven federative units of Brazil from 2006 to 2017. This variable is based on basic concepts of capitalism and globalization, whose exchanges of goods conducted by different countries promote mutual benefits and economic development. The extraction of export and import data for the formation of the openness variable was performed using the Federal Government’s bases of the Ministry of Industry, Foreign Trade, and Services. The data are available on the Brazilian foreign trade statistics dissemination system at the electronic address: http://comexstat.mdic.gov.br/pt/home. This database contains detailed queries on exports and imports since 1997.
The equation used for the values of Openness of the economy was:

\[
\text{Openness} = \left( \frac{E_{jt} + I_{jt}}{PIB_{jt}} \right) \times 100
\]

in which, \(E_{jt}\) and \(I_{jt}\) represent, respectively, the value of exports and imports from a given region \(j\) of the federative unit in a given period \(t\). While \(PIB_{jt}\) represents the value of the gross domestic production of the same region \(j\) for the same period \(t\). This equation is similar to the degree of openness (GA) used in the study by Cavalcante; De Oliveira; Maia (2017) and referenced by Lobejón Herrero (2001). Export and Import data that are expressed in US$ FOB (Free on Board, measured in US currency) signals that the buyer assumes all the risks and costs of transporting the goods counted and were extracted from the base in US currency and then converted into Brazilian currency (R$), for the construction of the variable.

Complementarily, for information purposes, GDP was deflated using the General Price Index (IGP-DI), available on Ipeadata. As GDP refers to domestic availability, the literature suggests deflation by the IGP-DI. Thus, all other series were deflated by it and adapted to 2010 values. The process of converting the export and import base into Reais (R$) followed the same rite applied in study by Cavalcante; De Oliveira; Maia, (2017, p. 15) before directly finding the value of annual exports and imports in reais, it was initially decided to obtain such values, month by month, in dollars and then a nominal monthly exchange rate was applied for each month of the said year, bringing the monthly values of exports and imports per month in reais. Then, the monthly values, already converted into reais, were added up, thus finding the annual values of exports and imports for the country and the twenty-seven federative units of Brazil.

Term and Demand Deposits were extracted at 2010 prices via the Central Bank of Brazil from 2006 to 2017. The data were included in the study as variables that produce a multiplier effect on the economy, as they can transform into productive investments through the financial system, with monetary characteristics, and with the Keynesian effect, becoming present in the GDP equation. Hence, the monetary multiplier occurs through the banking system to broaden the monetary base. In contrast, the Keynesian Multiplier occurs when the company increases its investments and, consequently, it will foster an increase in production and income, with a positive effect on GDP. In an explanatory way, the variables Term and Demand Deposits have already been written off at constant 2010 values. Given the scarcity of academic studies on the Brazilian case, it was decided to use other control variables: Current Expenses and Capital Expenses, such as government expenditures, also used here as an agent of the multiplier effect of the economy. Capital Expenses act directly in the production and generation of new goods or services through the formation or acquisition of capital goods. In Table 2, presented below, the main studies in synergy with this research are shown:
Among several computational packages available in the literature, as an econometric analysis tool, the STATA software was chosen in this study. Due to its broad applicability in econometrics and microdata analysis, it offers a variety of statistical techniques necessary and sufficient to support this research. Before transcribing the variables inserted into the model, it is important to emphasize that the descriptive statistics of all variables and the correlation matrix were calculated. The results are shown respectively in Tables 3 and 4. Table 3 shows the descriptive statistics of the variables of the empirical models, highlighting that the variable “economic openness” shows a higher standard deviation, which is justified because it was calculated in terms of rates and, therefore, the use of a logarithm. Besides, all variables were deflated.

Table 2: Theoretical and empirical reference of the variables used in the econometric model

<table>
<thead>
<tr>
<th>Variable Code in STATA</th>
<th>Description</th>
<th>Theoretical and empirical reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>State GDP at current prices (deflated by the IGP-DI).</td>
<td>Missio et al. (2010), Levine (1997), Hasan et al. (2009)</td>
</tr>
<tr>
<td>Openness</td>
<td>Degree of openness of the economy</td>
<td>Marques Jr. and Porto Jr. (2004),</td>
</tr>
<tr>
<td>Term deposits</td>
<td>Term bank deposits.</td>
<td>Missio et al. (2010), Marques Jr. and Porto Jr. (2004),</td>
</tr>
<tr>
<td>Demand deposits</td>
<td>Demand bank deposits.</td>
<td>Missio et al. (2010), Marques Jr. and Porto Jr. (2004),</td>
</tr>
<tr>
<td>Actual current expense</td>
<td>Government spending (Current expense)</td>
<td>Elaborated by the authors</td>
</tr>
<tr>
<td>Actual capital expenditure</td>
<td>Government spending (Capital Expenditure)</td>
<td>Elaborated by the authors</td>
</tr>
</tbody>
</table>

Source: elaborated by the authors.

Table 3: Descriptive statistics of the variables inserted in the model

<table>
<thead>
<tr>
<th>Variable Code</th>
<th>n</th>
<th>Average</th>
<th>D. P.</th>
<th>Min</th>
<th>0,25</th>
<th>Median</th>
<th>0,75</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnPIB_Real (InGDP_Real)</td>
<td>324</td>
<td>17.85</td>
<td>1.23</td>
<td>15.30</td>
<td>17.01</td>
<td>17.83</td>
<td>18.65</td>
<td>20.91</td>
</tr>
<tr>
<td>Abertura (openness)</td>
<td>324</td>
<td>17.49</td>
<td>13.54</td>
<td>0.35</td>
<td>5.16</td>
<td>15.51</td>
<td>27.60</td>
<td>59.41</td>
</tr>
<tr>
<td>lnDepositos_a_prazo (InDeposits_Term)</td>
<td>324</td>
<td>15.41</td>
<td>1.71</td>
<td>11.58</td>
<td>14.31</td>
<td>15.13</td>
<td>16.48</td>
<td>19.84</td>
</tr>
<tr>
<td>lnDepositos_a_vista (InDeposits_Demand)</td>
<td>324</td>
<td>14.63</td>
<td>1.31</td>
<td>11.90</td>
<td>13.75</td>
<td>14.55</td>
<td>15.56</td>
<td>18.30</td>
</tr>
<tr>
<td>Lndespesas_Correntes (LnCurrent_Expenses)</td>
<td>324</td>
<td>22.97</td>
<td>0.97</td>
<td>20.94</td>
<td>22.31</td>
<td>22.89</td>
<td>23.52</td>
<td>25.70</td>
</tr>
<tr>
<td>Lndespesas_Capital (LnCapital_Expenditure)</td>
<td>321</td>
<td>20.69</td>
<td>0.90</td>
<td>18.41</td>
<td>20.12</td>
<td>20.59</td>
<td>21.21</td>
<td>23.58</td>
</tr>
</tbody>
</table>

Source: Elaborated by the authors based on the Stata program.
REGRESSION MODEL WITH PANEL DATA

According to Hsiao (2005), panel data or longitudinal data usually refer to data containing time series observations of several individuals. Therefore, observations in panel data involve at least two dimensions; a transversal one, indicated by the subscript $i$, and a time series dimension, indicated by the subscript $t$. However, dashboard data may have a more complicated grouping or hierarchical structure. The econometric modeling used in this study employs the regression technique with panel data, where the database denotes this characteristic within the scope of data exploration. The starting point is the estimation of panel data (in the pooled model), arrangements with the fixed and random effects model, and applying the appropriate robustness tests to choose the best econometric model.

In general terms, regression with panel data, the origin of the modeling, is described in equation 1:

$$Y_{i,t} = \alpha_i + \beta_1 X_{1,i,t} + \beta_2 X_{2,i,t} + \cdots + \beta_k X_{k,i,t} + \epsilon_{i,t}$$

Where explanatory variables may contain lags, differences, or even various types of dummy variables, the coefficient $\alpha_i$ is estimated, according to the literature, in two situations, as an estimator of random effects, where $\alpha_i$ are random terms, not correlated with the errors ($\epsilon_{i,t}$); and in the case of fixed effects estimator, where the hypothesis that the coefficient $\alpha_i$ is not correlated with the error ($\epsilon_{i,t}$) is not valid. Thus, the analysis of the categorical factors of the Real GDP activities (PIB_REAL) of the States will be developed through an econometric model to be estimated, in the stacked data format, using the Stata statistics software, simulated by the regression equation.

The regression with panel data estimated in this study is arranged in equation 2, where $\beta_1$ to $\beta_5$ represent the parameters to be estimated from $\beta_1$ to $\beta_5$, $\alpha$ represents the vector of specific effects for each state, and $\epsilon_{i,t}$ defines the error term in equation 2:

$$\ln\text{PIB REAL (it)} = \alpha + \beta_1 \times \text{Abertura(it)} + \beta_2 \times \text{Indepositos_a_prazo(it)} + \beta_3 \times \text{Indepositos_a_vista(it)} + \beta_4 \times \text{Indespesas_Correntes(it)} + \beta_5 \times \text{Indespesas_Capital(it)} + \epsilon(it)$$

EMPIRICAL RESULTS

The tests were sequentially estimated from the econometric model for panel data to evaluate which model would be adopted (Pooled, Fixed Effect, or Random Effect). The difference between them lies in the assumption of the existence and characteristics of a component called unobserved heterogeneity. In this case, it would be a variation or differences between the cases that are not measured. The Chow test was performed to determine which model would be adopted. It makes it possible to evaluate the stability and predictability of the estimated model, placing it as an important test in the econometric model. According to Wooldridge (2002), the Chow test has the following hypotheses, Ho: Pooled model and H1:
Fixed Effects model. The result pointed to the rejection of Ho, that is, the test was significant at less than 1% probability (Prob > F = <0.0001), rejecting the Pooled method and adopting the Fixed Effects one. The Hausman test was used to estimate the Fixed and Random Effects models. The main difference between the two models is the validity of the hypothesis that the specific characteristics are not correlated with some regressor. In this sense, we used the Hausman Test to validate the following hypotheses, Ho: Random Effects model (specific characteristics are not correlated with repressors) and H1: Fixed Effects model (specific characteristics are correlated with repressors). The result was reflected by the rejection of Ho at 1% significance (Prob>chi2 = <0.00001). In summary, the hypothesis that the Random Effects model is more adequate than the Fixed Effects model is rejected.

Regarding the presence or absence of unobserved effects, the Breusch-Pagan test was used to verify if the variance of the unobservable component is greater than zero, which would indicate that the Random Effects model is more appropriate than the pooled one. Evaluating the result, it was concluded that the model estimates with random effects were significant at 1%. In this sense, the null hypothesis of the absence of unobserved effects is discarded. In the case of applications previously conducted, where it was found that the Fixed Effects model is more appropriate than the Pooled one and that the same happens with the Random Effects model, it is concluded that the Hausman test solved the problem in the previous step.

Considering that the Brazilian Federative Entities have some characteristics typical to their formation and that many are not observed, this could generate a problem of unobserved heterogeneity. In this sense, applying a Heteroscedasticity/Homoscedasticity test was necessary to evaluate the model. In this case, it was found that by rejecting Ho (presence of homoscedasticity), the model presents heteroscedasticity that was mitigated with applications of the double-log model and the use of certain lags (time differences). The tests show that the fixed effect model is superior, and that the heteroscedasticity problem has been corrected. It is worth noting that the estimate uses both state and time unit dummies. In Table 4, we present the result of the model estimations:

Table 4: Results of the estimations conducted for the model in panel data with fixed effect by U.F. and time fixed effect

| InPIB_Real (lnGDP_Real) | Coef.  | Robust Std. Err. | t       | P>|t| |
|-------------------------|--------|------------------|---------|------|
| Abertura (Openness) L1 | 0.005069 | 0.0011285 | 4.49 | 0.000 |
| lnDepositos_a_prazo (lnDeposits_Term) L1 | 0.0389817 | 0.0164502 | 2.37 | 0.026 |
| lnDepositos_a_vista (lnDeposits_Demand) L1 | 0.0829818 | 0.0394147 | 2.11 | 0.045 |
| lnDespesa_Correntes (lnExpenses_Current) L1 | 0.2123113 | 0.0767722 | 2.77 | 0.010 |
### Table 1: Estimation Results

| lnPIB_Real (lnGDP_Real) | Coef.       | Robust Std. Err. | t     | P>|t| |
|------------------------|-------------|------------------|-------|-----|
| In_Despesas_Capital (lnCapital_Expenditures) L1 | 0.0138302   | 0.0128951        | 1.07  | 0.293 |
| Year                   |             |                  |       |     |
| 2008                   | 0.0150307   | 0.0141827        | 1.06  | 0.299 |
| 2009                   | 0.0545795   | 0.0195779        | 2.79  | 0.010 |
| 2010                   | 0.1546463   | 0.022389         | 6.91  | 0.000 |
| 2011                   | 0.1759974   | 0.0276043        | 6.38  | 0.000 |
| 2012                   | 0.2151082   | 0.0314205        | 6.85  | 0.000 |
| 2013                   | 0.2310952   | 0.0327447        | 7.06  | 0.000 |
| 2014                   | 0.2763134   | 0.0378644        | 7.30  | 0.000 |
| 2015                   | 0.2595565   | 0.0446024        | 5.82  | 0.000 |
| 2016                   | 0.2352606   | 0.0529698        | 4.44  | 0.000 |
| 2017                   | 0.3059583   | 0.0521107        | 5.87  | 0.000 |
| cons                   | 10.64773    | 1.752286         | 6.08  | 0.000 |

Notes:
- L1: one period lag
- cons (constant = year 2007)

Tests:
- Breusch Pagan 432.64***
- Chow test 20.16*** (Prob > F = 0.0000)
- Hausman test: chi2 = 194.55 (Prob>chi2 = 0.0000)***
- Heteroscedasticity Test chi2 = 19753.58 (Prob>chi2 = 0.0000)***

Conclusão

Source: elaborated by the authors based on the Stata program.

Note: 1) t and z statistics (in the case of random effects); 2) Significance levels: ***: Significant at 1%; **: Significant at 5%; *Significant at 10%.

One of the premises of the Regression model is that it does not have endogeneity. To solve any dynamic endogeneity problem, we used lags, that is, applying temporal differences of the original regressors. In this sense, the past explains the present. The lagged variables begin to explain the GDP in a period. Thus, the lag operator "L" is defined as a linear operator, which by definition is described in equation 3:

\[ L_t = Y_t - \tau \]

where: \( L_t \) simply means the lag of \( Y_t \) by \( \tau \) “periods……..” 

(3)

Based on table 4, it is observed that the variable that represents the openness (abertura), which is the sum of exports plus imports, divided by GDP, generated a positive sign of its coefficient and presented a significant estimate at the level of 5% of significance. The average increase of 1% in “Openness” will generate an increase of 0.005069%
in GDP. In this sense, it is observed that the opening of the market in the federative units generates an increase in GDP, as both exports and imports have a positive impact on the overall result. The coefficient of the term deposits variable (lnDepositos_a_prazo) was positive and a significant estimate at a 5% significance level. The 1% average increase in term deposits (lnDepositos_a_prazo) will generate an increase of 0.0389817% in GDP. According to Missio et al. (2010) it also supported by the reference of King and Levine (1993), who corroborate that this is an important variable of financial intermediation.

From the same point of view, the coefficient of the demand deposit variable (lnDepositos_a_vista) was also positive and presented a more significant estimate at a 5% significance level. The 1% average increase in demand deposits (lnDepositos_a_vista) will generate a 0.0829818% rise in GDP. The result is also associated with the studies by Missio et al. (2010) and King and Levine (1993) as an important variable of financial intermediation from the perspective of financial development. From the perspective of the expenditure variable (lnDespesas_Correntes) as State government expenditure, generating a multiplier effect on the economy, it can be seen that an average 1% increase in State expenditures will generate a 0.2123113% rise in GDP, which is significant at a 95% confidence level.

Finally, the coefficient of the capital expenditure variable (lnDespesas_Capital) was not significant at either 5% or 10%. In this sense, reference is made to Silva and Scantolin (2012), where, for example, they suggest “that the increase in public spending on infrastructure as a proportion of GDP would positively and significantly impact the economic growth of Brazilian states.” It can also be observed that only the 2008 temporal dummy was not statistically significant. As a robustness test, we have used table 5 under the same model as table 4 but with a single difference: instead of using dummies by State, they are used by the region. In this context, one can assess the regional effects of financial development on the level of economic activity, that is, on real GDP.

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instead of using *dummies* by State, they are used by the region. In this context, one can assess the regional effects of financial development on the level of economic activity, that is, on real GDP. The empirical results in table 5 are similar to those in table 4.

Based on the results presented in table 5, it is observed that the Central-West region was omitted, and, in this case, we can compare the other regions with the Central-West. However, it is worth noting that the North and Northeast regions are the poorest, while the other regions are the richest, the Central-West, South and Southeast regions.

It can be seen in the last five lines of table 5 the estimated coefficients with negative signs of the northeast and north regions with values of -0.2006497 and -0.4183415, respectively. As the constant term is equivalent to 0.8692515, this means that the effects of the two poorest regions on real GDP are smaller than the Central-West region when we compute the sum between the constant term and the estimated coefficients of the North and Northeast. In this way, we have that the effect of the northeast region is equivalent to \((-0.2006497 + 0.8692515) = 0.6686018\) and the impact of the north region is equivalent to \((-0.4183415 + 0.8692515) = 0.45091\). Such results show that the effects of the poorest regions on real GDP are smaller than those of the Central-West. However, as the constant term is statistically equal to zero, the empirical results show that the effects of the North and Northeast regions are negative and equivalent to the values -0.2006497 and -0.4183415, respectively.

Table 5: Results of the estimations performed for the model in panel data by geographic regions

| lnPIB_Real         | Coef.  | Robust Std. Err. | z     | P>|z| |
|-------------------|--------|------------------|-------|------|
| (lnGDP_Real)      |        |                  |       |      |
| Abertura (Openness) | 0.0044178 | 0.0019329        | 2.29  | 0.022|
| L1                |        |                  |       |      |
| lnDepositos_a_prazo (lnDeposits_Term) | 0.0896058 | 0.0148127        | 6.05  | 0.000|
| L1                |        |                  |       |      |
| lnDepositos_a_vista (lnDeposits_Demand) | 0.2400391 | 0.0488488        | 4.91  | 0.000|
| L1                |        |                  |       |      |
| lnDespesa_Correntes (lnExpenses_Current) | 0.5130734 | 0.0626129469     | 8.18  | 0.000|
### Conclusão

| lnPIB_Real                    | Coef.   | Robust Std. Err. | z      | P>|z| |
|------------------------------|---------|------------------|--------|-----|
| In_Despesas_Capital          | 0.0161793 | 0.013052        | 1.24   | 0.215 |
| (InCapital_Expenditures)     |         |                  |        |     |
| L1                           |         |                  |        |     |
| Year                         |         |                  |        |     |
| 2008                         | -0.0414987 | 0.016725          | -2.48  | 0.013 |
| 2009                         | -0.0190738 | 0.0177383        | -1.08  | 0.282 |
| 2010                         | 0.0495138  | 0.0177427        | 2.79   | 0.005 |
| 2011                         | 0.0409438  | 0.0202856        | 2.02   | 0.044 |
| 2012                         | 0.0781598  | 0.0228342        | 3.42   | 0.001 |
| 2013                         | 0.0557797  | 0.0279597        | 1.99   | 0.046 |
| 2014                         | 0.1087577  | 0.032427         | 3.35   | 0.001 |
| 2015                         | 0.1010763  | 0.0388181        | 2.60   | 0.009 |
| 2016                         | 0.1166485  | 0.0478481        | 2.44   | 0.015 |
| 2017                         | 0.1915509  | 0.0467817        | 4.09   | 0.000 |
| Region                       |         |                  |        |     |
| Northeast                    | -0.2006497 | 0.0699710        | -2.87  | 0.004 |
| North                        | -0.4183415 | 0.1492587        | -2.80  | 0.005 |
| Southeast                    | 0.1078215  | 0.1319748        | 0.82   | 0.414 |
| South                        | 0.1491533  | 0.0852932        | 1.75   | 0.080 |
| _Cons                        | 0.8692515  | 0.0861580        | 0.80   | 0.424 |

Source: elaborated by the authors based on the Stata program.

Note: 1) t and z statistics (in the case of random effects); 2) Significance levels: ***: Significant at 1%; **: Significant at 5%; *Significant at 10%.

It is also worth noting that the Southwest region has a statistically null estimated coefficient; therefore, this region’s contribution to economic growth is equal to that of the Central-West region. Finally, it is observed that the effect of the South region on real GDP is positive and is greater than the contribution of the Central-West region in the amount of \((0.1491533 + 0.8692515) = 1.0184048\).

Such empirical results show the need to rescue the poorest regions through public policies that can foster the economic development of the North and Northeast regions.

**CONCLUSIONS**

This paper has developed an empirical analysis to study the relationship between economic growth and financial development for the national case involving the Federative Units of Brazil. The methodology used was the regression technique with panel data applied to data collected from Brazilian states.
The evidence of this study points to a positive and significant relationship regarding the empirical results, thus producing important findings for the academic world. The research adhered to the line of thought raised by King & Levine (1993), whose central idea is anchored in the statement that financial development implies economic development. The findings were also strongly related to the results of Missio et al. (2010) and Marques Jr. and Porto Jr. (2004) for the national case, even using another econometric technique, which makes this study relevant.

This article leaves the possibility open for evaluating why the capital expenditure variable (InDespesas_Capital) was not significant at 5%. One hypothesis to be tested is that service sector variation has a greater impact on economic growth. In this sense, the possibility of evaluating the multiplier effect of the service sector on the economy through a framework broken down by State, makes room for future study. In this context, one contribution of this study is the introduction of two explanatory variables that are not usual in the literature on the subject when introducing current and capital expenditures.

The empirical results also show the regional imbalances between the poorest and most prosperous regions, highlighting the need to create incentive systems via public policies so that the North and Northeast regions can achieve standards of living and development closer to those of other regions.

It is important to emphasize that this study does not have the as main objective to promote the discussion about the State expenditure variables, which is a conflicting topic in the literature, especially regarding the short- and long-term effects on GDP. However, one of the empirical results of this research showed a positive and statistically significant correlation between current expenditures and economic growth. Still, such correlation was not statistically significant for capital expenditures, based on the empirical models constructed. However, this is an excellent opportunity for further studies, understanding that there is good motivation to investigate these short and long-term effects of public spending on growth. Thus, another contribution of this study is to motivate new research, generating results through other econometric techniques and applying them to a set of countries, using the same variables in this study to produce new findings. In a complementary way, this study sought to contribute to the scarce national literature on the subject, making it possible to expand the prism of the studies using a perspective from Brazil.

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