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ORIGINAL RESEARCH

The Effects of Public Expenditure on Municipal Development: A Dynamic Panel Approach

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Abstract
We investigate the effects of public expenditure on municipal development in the state of Rio Grande do Sul, Brazil. The definition of development adopted is based on the capability approach, and the methodology used is that proposed by Hsiao et al. (J Econom 109(1):107–150, 2002. https://doi.org/10.1016/S0304-4076(01)00143-9), in which dynamic panels with fixed effects are estimated using quasi-maximum likelihood estimators. The study's contributions include the econometric approach used and the concept of multidimensional development as a dependent variable. The results point to the positive effects of public expenditure in all the analyzed scenarios. These effects are not linear, being up to 2.7 times higher among municipalities with the lowest *per capita* expenditure. This analysis lends weight to the suggestion that allocative redistribution of expenditure could positively impact people's living conditions without increasing its overall volume.

Keywords Public expenditure · Human development · Effects of public expenditure · Dynamic panels

JEL Classification H5 · O2

1 Introduction

Recent years have seen one of the worst state-level fiscal crises in the modern history of Rio Grande do Sul, Brazil, which in 2019 is completing four years of successive delays in paying the salaries of public employees and obligations to suppliers. The combination of a historically deficient fiscal structure, a particularly adverse economic scenario and the continued growth in current expenditure suggests that the situation in the coming years will

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be delicate. Complex fiscal solutions are needed to provide even the most essential services (Petry et al., 2018).

In this scenario, reviewing government revenues and expenditures plays a central role in public debate. While, on the one hand, revenues are strongly correlated with the performance of the national economy, on the other hand, the state and municipal expenditure structures are quite rigid. A potential control of the expenditure growth could be achieved by three different strategies: to change the rules that determine its dynamics, to reformulate the social contract, and to determine the effectiveness of expenditure and government programs (Braatz, 2016). Although it would be reasonable to argue that the three initiatives should be jointly considered, the understanding of the expenditures' impact is a key issue.

Despite its crucial importance, however, there is not fully consolidated knowledge about the impacts of current levels of public expenditure on socioeconomic indicators. Part of the difficulty in gauging these effects is the concentration of municipal and state budgets in current expenditures, especially in the payment of public employees (Santos et al., 2017). This means that attempts to evaluate the effectiveness of public policy often address very tiny fractions of total expenditure.

The international empirical literature on the influence of public expenditure on income is extensive, but inconclusive. Widely used, causality testing approaches have found positive, null, and even negative results depending on the modelling and the sample considered (Idenyi et al., 2016; Uzuner et al., 2017). In relation to social indicators, more specifically education and health, estimates tend to point out positive effects of public expenditure, but income and prior educational status usually account for most of the variations (Hu et al., 2017; Mello & Pisu, 2009).

Taking into consideration both the fiscal challenges faced by the State and the lack of stablished consensus in the current literature, the main objective of this paper is to estimate the effects of public expenditure, at the municipal and state level, on the development of the municipalities in Rio Grande do Sul, Brazil.

Although empirically focused on a particular Brazilian state, the methodological approach we adopted to accomplish the main objective offers a twofold contribution. Firstly, the definition of development used is not unidimensional, but rather adopts the multidimensional Human Development approach, based on Amartya Sen's Capability Approach. Accordingly, substantive freedoms are the main value and development is a process of expansion of people's freedom to choose the life they want to live (Sen, 1999).

The bases for measuring this process are established in the Human Development Report of 1990, where is stated that the Capability Approach constitutes its main theoretical reference (UNDP, 1990). The Human Development Index (HDI) was the central theme of that report, focusing on three essential elements of human life: longevity, knowledge, and a decent standard of living. For the present study, we use a similar method to construct a composite development index for the municipalities. The appropriate annual data were collected for the 496 municipalities in the state from 2004 to 2016.

The second contribution of our study regards the technique applied to estimate the effects of expenditure on development, which is based on Hsiao et al. (2002). Differently from most of the current literature on the topic, dynamic panels with fixed effects are specified and estimated using quasi-maximum likelihood estimators (QML). Having the human development index as the dependent variable, the proposed model accounts for the effects of both the time-invariant unobservable variables and of the lagged dependent variable itself. Furthermore, it is also controls for the variation in the demographic structure, presence of federal and private education institutions, and values received via conditional income transfers from the Federal Government.

Only a few papers have used dynamic panels to study the effects of public expenditures on socioeconomic indicators. When they do implement such an approach, as Cruz et al. (2010), Martins and Veiga (2014) and Ssozi and Amlani (2015), for example, they predominantly apply the generalized method of moments (GMM) technique as proposed by Arellano and Bond (1991). The QML estimator, as used in this study, is poorly represented in the empirical literature (Kripfganz, 2016), although it is superior to GMM in many applications (Moral-Benito, 2013).

The next sections are presented as follows: Sect. 2 provides a review of the most recent empirical studies that have sought to measure effects of public expenditure on socioeconomic indicators; Sect. 3 presents the data and describes the methodology for constructing the municipal development index and estimating the effects of expenditures; Sect. 4 offers a discussion of the findings; Sect. 5 presents the conclusions that can be drawn from the study.

2 Literature Review

The theoretical approaches adopted in relation to public expenditure have varied significantly throughout history in response to economic, institutional and philosophical changes. The prevailing political principles and values of each era have played a key role in the evolution of the theory of public finances, and consequently in the understanding of which services should be provided by the public sector and in what quantities. While the shift from John Locke's entitlement rules to Jeremy Bentham's utilitarian model altered the assumptions held regarding justice in taxation, the growth of egalitarian philosophy led to the increasing importance of government transfers. In modern times, the way the role of the state is seen has been significantly altered by the growth of the democracies, where the political contest for control of the public budget has replaced barricades in the struggle among classes and interest groups (Musgrave, 1985).

This changing perspective regarding the role of the state has been accompanied by an evolving literature on the impacts of public expenditure on socioeconomic performance. In the next sections we present a review of the cotemporary research on the topic.

2.1 Public Expenditure and Economic Growth

The Great Depression of 1929 strongly influenced the vision of government performance and fiscal policy. With the rise of the Keynesian model and the belief that government should act to stabilize the product level, the effects of public expenditure on GDP became the focus of attention (Stiglitz, 1986). In this context, the empirical literature is rich in studies that attempt to estimate these effects, although with varied results. Positive effects were found in recent studies by Uzuner et al. (2017), Hakooma and Seshamani (2017), Hassan and Mishra (2017), Dogan and Tang (2006), Mallick et al. (2016), Benedict et al. (2016), Dastidar and Cchatterji (2015) and Torruam et al. (2014), which used causality tests between public expenditure and economic growth in Turkey, India, the Philippines, Asia and Africa.

These techniques have been widely used because they permit assessment of the direction of causality, that is, to determine whether expenditure causes GDP growth or, conversely, it is increased product that leads to rising expenses. Abdelkader et al. (2017), Cchingoiro and Mbulawa (2016), Benedict et al. (2016), Torruam and Abur (2014) and Wu

et al. (2010) found two-way causality relations between expenditure and economic growth in some of the analyzed countries, while Idenyi et al. (2016), who focused on African countries, reported their estimates showed growth causing increased expenditure. In this case, an exogenous variation in public expenditure would not influence GDP.

Depending on the techniques used and the samples analyzed, studies that indicate expenditure has negative effects on the product can also be found. Churchill et al. (2017) concluded that government size tends to have a negative impact on economic growth in developed countries, although they stress the importance of being cautious in establishing this type of causal relationship. The authors used meta-analysis of 799 estimates in 87 primary studies to estimate the effects.

Some studies suggest the way in which expenditure is distributed, whether by economic category or function, exerts an influence on the sign and magnitude of the effects on economic growth. Bahaddi and Karim (2017), Yovo (2017) and Hussain et al. (2017) estimated positive effects for investment and negative effects for current expenditure on GDP in Morocco, Togo and Pakistan. Reinforcing the conclusions in these studies, Butkiewicz and Yanikkaya (2011) also estimated negative impacts of current expenditure on growth from a sample of 100 countries.

Expenditure by function, that is, by sector in which it is applied, has also been subject to assessments regarding their effects on GDP. Nurudeen and Usman (2010) found spending had negative impacts on education and capital and current expenditure, and positive impacts on health, transportation, and communications in Nigeria. Manamperi (2016) specifically analyzed the effects of military spending on GDP and found negative effects in Turkey and null effects in Greece. Balaj and Lani (2017) estimated the effect of disaggregated expenditure on ten functions in Kosovo and it had no significant effect on growth.

2.2 Impacts on Socioeconomic Indicators

Various techniques have been used to investigate the effects of public expenditure on socioeconomic indicators. The study by Cruz et al. (2010), for instance, found that spending on education, health, roads and energy was found to have positive effects on the *per capita* GDP of Brazilian municipalities. But for many years, excessive concern with economic growth has obscured the real purpose of development—which is to benefit people—and shifted attention from the end to the means. High rates of aggregate growth do not necessarily guarantee the reduction of socioeconomic deprivation, healthy lives and freedom of choice (UNDP, 1990). Among the studies that seek to estimate the effects of public expenditure on people's living conditions, unidimensional assessments predominate.

In the health area, recent empirical studies point to mixed results. Although they tend to point towards positive effects of expenditure on longevity, the conclusions vary depending on the health-specific spending. Linden and Ray (2017), Ssozi and Amlani (2015), Aisa et al. (2014) and Baldacci et al. (2008) estimated positive impacts of public expenditure on health regarding life expectancy in the analyzed countries. The results reported by Van den Heuvel and Olaroiu (2017), on the other hand, indicate that health spending does not significantly impact life expectancy. The variation in longevity was mainly explained by spending on social security and the lifestyle of the populations.

The literature is also inconclusive in relation to the effects of sectoral expenditure on education indicators. In one of the first attempts to find determinants of educational processes, the Coleman Report (Coleman et al., 1966) identified no significant relationship between school inputs and performance. Despite the resulting controversy, a large body of

literature came to confirm many of the original findings, and much of the research shows expenditure has no consistent or systematic influence on student performance (Hanushek, 2013).

Despite this, recent studies have brought dissonant evidence, such as Dalis et al. (2017), Okanta and Idika (2017), Baldacci et al (2008) and Gupta et al. (2002), who found positive effects of education spending on enrollment rates, the reduction of illiteracy and school attendance in several countries. Hu et al. (2017) used a multilevel structural equation model to investigate the relationship between infant education expenditure and academic outcomes in 59 classes in Guangdong Province, China. Although some positive effects were found, the estimates show that control variables, both at the school and student levels, such as gender and socioeconomic conditions, accounted for most of the variation.

In fact, the complexity of the phenomena involving the human condition, and the interrelationship between socioeconomic variables, such as income, health, and education, tend to make sectoral studies to underestimate the impact of government expenditure on social conditions. This is one of the main findings of Mello and Pisu (2009), who studied the effects of spending on health and education in Brazilian municipalities.

In that study, income is shown to be the main determinant of social indicators. However, due to the methodology applied, it is not possible to investigate if the relation is unidirectional or bidirectional—this means the hypothesis that social indicators, such as educational status, determine income cannot be excluded. Specific expenditure on health and education have had more modest effects than other government expenditure, confirming the importance of evaluating the effects of overall expenditure, not just specific functions. Strong cross-effects were also found between health and education indicators.

2.3 Human Development as a Multidimensional Approach

Despite the merit of shifting the focus from the means alone (aggregate income) to the ends (healthy living, instruction), sectoral assessments do not encompass the multidimensionality necessary to infer the impact of expenditure on people's lives. This focus on people is central to Sen's Capability Approach, which redefined the concept of development, being now understood as a process of expanding people's freedom to choose the life they value and want to live (Sen, 1999).

The main components of this approach are functionings and capabilities. The former reflect what people actually are or do, from being well fed and healthy, to sustaining self-esteem or participating in civil society. Capabilities are those functionings that are not necessarily performed by the individual, but which are available. The set of capacities available to a person is called a capability set, ultimately reflecting the individual's freedom of choice (Sen, 1985).

Thus, people would convert material resources (the means), using personal, social and environmental conversion factors into a set of potential functionings (the ends). Given these possibilities, and considering each individual's view of what a full life is, they undertake the chosen functionings. Of course, the approach leads to an expanded informational space and, consequently, to a significant increase in the analytical framework necessary for its operationalization (Robeyns, 2005; Sen, 1985).

The Human Development Report of 1990, which adopted Sen's capability approach as its main theoretical reference, established the most widely-used basis for measuring this multidimensional understanding of development: the Human Development Index (HDI).

This index focuses on three essential elements of human life: longevity, knowledge, and standard of living.

Studies that seek to estimate the relationship between public expenditure and the HDI are scarce. Martins and Veiga (2014) analyzed the effects of government size and the composition of public expenditure on the HDI using GMM. Based on a panel of 156 countries and 5 periods, they concluded that government size has an inverted U-shape effect on the rate of growth of the HDI, with a peak at 17% of GDP. Torres (2012) also found social spending had significant effects on the HDI in Bogotá, Colombia. However, prudence is required when analyzing the results, as the methodology used is not very robust.

Human development is a complex and multidimensional phenomenon, which imposes considerable methodological challenges on researchers interested in assessing the impact of public expenditure. As can be concluded from the literature review, the interdependence between socioeconomic dimensions, the consequent influence of more than one expenditure function on the same variable, and the importance of the initial socioeconomic status in the way indicators will respond to the variation in expenditure are only a few aspects to be faced.

Evidently, public expenditure is of relevance for government decisions and economic debate, as well as the need to deepen knowledge about their effects on people's lives. The methodological approach used in this study presents advances in relation to studies carried out to date insofar as it adopts a multidimensional vision of development, which is not represented in the empirical literature, and provides the opportunity to deal more robustly with the challenges arising from the expansion of the informational space.

3 Methodology

Given the complexity of the development concept adopted here, the first challenge is how to deal with the interdependence between the socioeconomic dimensions. It is known, for example, that educational status is a determinant of the health of a population and vice versa, especially in municipalities with poorer social status. Thus, spending on education can also be expected to have effects on health indicators and, conversely, health spending may influence educational status. This reasoning can be repeated for other socioeconomic dimensions, such as income.

Thus, a strategy of assessing the effects of global public expenditure, rather than sectoral expenditure, on a multidimensional index such as the HDI, rather than on specific variables, seems to be the most appropriate. Therefore, the focus of this study is the estimations of the effects of total public expenditure on a proposed development index. Even knowing the limitations, the assessments of the impacts on the sub-indices are also used as an additional subsidy for the analyzes.

A second challenge is to deal with the intertemporal variation of effects, which can occur for various reasons. First, the initial social condition of a population is expected to affect how it reacts to a change in expenditure. In the specific case, considering also the interdependence between the previously explored dimensions, this means it is recommended that the model control the lagged dependent variable (the multidimensional development index).

In addition, it is impossible to determine the time elapsed since the expense was included in the accounts, through the effective implementation of the policy or public structure, until its impacts are actually felt. Moreover, the variation of the magnitude and

even the sign of the effects of public action over time are not fully known. The impact on an indicator in the year of the deployment of the policy may increase, decline, or even change signs in subsequent years. Given these intertemporal dynamics, the assessment needs to be longitudinal, to enable the heterogeneity of the effects to be investigated.

Finally, the third challenge concerns the definition and data collection of the set of variables to be controlled. The demographic profile and local culture, for example, are expected to influence how the municipality responds to changes in expenditure. Likewise, federal public investments and structures, exogenous to the model, may exert influence. Considering the data limitation, the model's specification needs to mitigate problems regarding omitted variables, which suggests the use of fixed effects.

Therefore, the estimation methodology used is that proposed by Hsiao et al. (2002). Dynamic panels with fixed effects are specified and estimated by quasi-maximum likelihood (QML). The models enable control over the effects of time-invariant non-observable variables and of the lagged dependent variable itself, in addition to the other explanatory variables, such as the variation in the demographic structure, and the presence of federal and private education institutions.

A development index was constructed for the municipalities using a methodology similar to that of the HDI to allow panel data analysis. The essential dimensions of human life are designed in sub-indices that aim to measure longevity, knowledge, and the standard of living. Annual data were collected from 496 municipalities in the state of Rio Grande do Sul, for the period ranging from 2004 to 2016, which gives a total of 6,449 observations.

3.1 Municipal Development Index

The ability to synthesize complex and multidimensional realities in order to subsidize the formulation of public policies is among the main advantages of the use of composite indicators. Nevertheless, such aggregation is subject to debate, especially because of the intrinsic arbitrariness of some phases in the process of constructing the indices, such as the attribution of weights to the variables to be combined (OECD, 2008).

With this in view, the development index used in the present study was built inspired by the methodology adopted to calculate the HDI. In addition to the theoretical concept, the methodology of standardization of variables, of attributing weights (equal weights between variables and sub-indices) and of aggregation (geometric mean) are analogous. But the need to work with data in annual bases prevents the selected variables from being the same. For example, there is no annual information available on average schooling, average *per capita* income and school performance per municipality.

Moreover, in relation to the selection of variables, the choice of the municipalities as the basis of the assessment imposes a second challenge, caused by the displacement of people between municipalities to work or study. Enrollment rates and occupancy rates, for example, are variables that are strongly impacted by these phenomena at the municipal level and so are not used.

In the same way, migratory flows are a cause for attention. A person may, for example, have access to poor quality health services in childhood that limit their life expectancy. But in the event of migration, the result of this low quality will be attributed to the municipality of destination, and not to that which effectively rendered the poor service. To mitigate these limitations, the present study gives preference to indicators that measure the conditions at the beginning of people's lives.

The constructed development index is a geometric mean of three sub-indices, as shown in Eq. 1.

$$DevI = \sqrt[3]{standard\ of\ living * knowledge * longevity} \tag{1}$$

Based on the available data, the index representing the standard of living is calculated from the standardized variables of formal income and the coefficient of variation (Eq. 2), obtained from the Social Information Annual Report (*Relação Anual de Informações Sociais*). The formal average income is related to the well-being obtained from the material aspects of life, also being related with the quality of jobs, while the coefficient of variation is selected to measure income distribution. As in the composite development index, the aggregation of variables is achieved using the geometric mean, which is more suitable in relation to the arithmetic because it smooths the effects of large disparities between standard variables.

$$standard\ of\ living = \sqrt[2]{income * Coef.\ of\ Variation} \tag{2}$$

For the longevity dimension, we chose to use the standardized indicator of the *per capita* potential years of life lost (*PYLL*) (Eq. 3), which estimates how many years each person would have lived had he not died prematurely (before the age of seventy). The choice is suitable for this study since it brings together different types of mortality, such as infant mortality, traffic accidents and homicides, as well as being more impacted when death occurs in the early years (Gardner & Sanborn, 1990; Perloff et al., 1984; Romeder & Mcwhinnie, 1977). The indicator was calculated based on the death rate by age group provided in the Ministry of Health's DATASUS.

$$longevity = PYLL\ per\ capita \tag{3}$$

In terms of the knowledge dimension, the availability of data and other constraints limit the index to flow variables, with school dropout rates being the most widely adopted in the empirical literature. Thus, we chose to calculate the index based on the elementary education dropout rate (*EEDR*) (Eq. 4) provided by the National Institute of Educational Studies and Research Anísio Teixeira—INEP.

$$knowledge = EEDR \tag{4}$$

To compose the index, all the variables used are linearized, using the maximum and minimum values in the observed series to limit the scale between zero and one, as shown in Eq. 5. Table 1 presents the descriptive statistics of the variables used.

Table 1 Descriptive statistics of the variables in the development index. *Source*: Authors' estimation

Variable	Description	Mean	SD	Min	Max
Income	Average formal remuneration (US$)	506.00	115.02	155.91	1,825.29
CV	Coef. of variation in income	0.7887	0.2126	0.3206	2.5141
EEDR	Elementary education dropout rate	1.4	1.4	0	22.7
PYLL	Potential years of life lost *per capita*	0.0637	0.0367	0	0.4507

$$Standardized\ variable = \frac{X_i - X_{minimum\ series}}{X_{maximum\ series} - X_{minimum\ series}} \quad (5)$$

3.2 Public Expenditure Data and Control Variables

Expenditure per thousand inhabitants is the sum of two different information sources. The public expenditure made through the municipal budget, obtained from FINBRA of the National Treasury Secretariat, and the public expenditure of the state budget allocated to the municipalities, obtained from the State Treasury Department of Rio Grande do Sul. All the values were updated to those of 2017 according to the official Consumer Price Index (IPCA).

In terms of control variables, the demographic structure is expected to influence how the municipal development index responds to changes in public expenditure. The control variables available for these aspects are the population size, the percentage of women, the age structure and the population density. These data were collected from the Department of Economics and Statistics of Rio Grande do Sul (DEE) and the Brazilian Institute of Geography and Statistics (IBGE).

Expenditure originating from the federal budget are exogenous to the model. The control variables available for these aspects are the total amount of benefits of the *Bolsa Família* program, obtained from the Institute for Applied Economic Research (IPEA), and the percentage of enrollments in federal educational institutions, provided by the National Institute of Educational Studies and Research (INEP). These variables are expected to have a positive influence on the development of the municipalities in which they are allocated.

Finally, the percentages of enrollments in private schools in the municipalities were also collected, in order to avoid assigning a positive variation in the index through any improvement in the educational status unrelated to public action. Table 2 shows the descriptive statistics for these variables.

3.3 Model

Panel data models offer two great advantages for investigating causal inferences with non-experimental data: the ability to control invariant non-observable variables over

Table 2 Descriptive statistics of the expenditure and control variables. *Source*: Authors' estimation

Variable	Description	Mean	SD	Min	Max
gc1000	Expenditure per inhabitant divided by 1000 (R$)	1.10	0.55	0.01	6.36
Pop	Population	22,018	77,408	1,147	1,481,019
PopD	Population density	79,636	27,809	.07	31,612
Popfem	% population female	49.8	13.8	41.7	53.8
pop15	% population $\leq$ 15 years	19.9	37.8	85.2	37.4
pop1560	% population between 15 and 60 years	63.8	24.8	52.2	71.8
pop60	% population > 60 years	16.3	40.6	62.2	37.4
EnFed	% enrolled in federal institutions	0.2	1.4	0	39.1
Enpriv	% enrolled in private institutions	3.1	5.8	0	37.9
Bfv	Total value of *Bolsa Família* benefits in R$	77,423	281,325	0	10,700,000

time and to model the direction of causal relationships (Allison et al., 2017). Unfortunately, estimating models that use fixed effects and lagged dependent variables as explanatory is problematic, presenting correlations between the error terms and the predictors, incidental parameters and uncertainty regarding the treatment of the initial conditions (Williams et al., 2018).

These problems are often treated using the generalized method of moments (GMM), proposed by Arellano and Bond (1991), which uses lagged variables as instruments. This approach provides consistent estimators for the coefficients, but there is evidence that estimates are not fully efficient and often perform poorly when the auto regression parameter approaches 1,0 (Williams et al., 2018). For Allison et al. (2017), GMM estimates suffer from three problems: they are biased for small samples, not fully efficient, and deal with the uncertainty in the choice of instruments.

According to Kripfganz (2016) while GMM estimates are attractive due to their flexibility and ease of implementation, other promising methods such as quasi-maximum likelihood (QML) remain poorly represented in the empirical literature. Moral-Benito (2013), suggests that the superiority of the maximum likelihood estimation methods in relation to the GMM is well known in the literature in terms of performance with finite samples, especially when the instruments are weak and/or numerous in relation to the sample size. Phillips (2018) also advocates in favor of QML estimations demonstrating that that if performs much better in comparison to GMM.

This study uses the method proposed by Hsiao et al. (2002), which applies an approach based on maximum likelihood estimates. The initial model is represented by Eq. 6, where $y_{i,t-1}$ is the lagged dependent variable, X_{it} is the vector of the explanatory variables, δ_i represents the time-invariant effect of each unit and ε_{it} is the error. The level model is transformed into the first difference (Eq. 7) to deal with the problem of the incidental parameters.

$$y_{it} = \gamma y_{i,t-1} + \beta X_{it} + \delta_i + \varepsilon_{it} \tag{6}$$

$$\Delta y_{it} = \gamma \Delta y_{i,t-1} + \beta \Delta X_{it} + \Delta \varepsilon_{it} \tag{7}$$

Considering the correlation between the initial observation Δy_{i1} and the transformed error term $\Delta \varepsilon_{it}$, estimating the conditional likelihood function, the Δy_{i1} would generate inconsistent estimators for finite T. To address this problem, it is necessary to specify the joint distribution of all the observations $\Delta y_i = \left(\Delta y_{i1}, \Delta y_{i2}, \ldots, \Delta y_{iT}\right)$ conditional to the strictly exogenous regressors X_{it}. Considering that Eq. 7 is unable to define Δy_{i1}, since que Δy_{i0} is not observable, the authors propose a process by which the initial conditions are generated in Eq. 8. The equation is a result of the continuous substitution of Eq. 7 and the result of its estimate generates the values of Δy_{i1}.

$$\Delta y_{i1} = b + \sum_{s=1}^{T} \Delta X_{is} \pi_s + \vartheta_{i1} \tag{8}$$

The advantages of the method have also been addressed by Phillips (2018), who establishes the almost certain convergence and asymptotic normality in level and first difference of the dynamic panel-data estimators with QML, besides the robustness in relation to the initial conditions, heteroscedasticity and specification of the function of the log-likelihood. The study uses Monte Carlo experiments to compare the performance of the QML and GMM estimators and to prove the advantage of the former.

Table 3 Development index descriptive statistics. *Source*: Authors' estimation

	Mean	SD	Min	1st quartile	2nd quartile	3rd quartile	Max
Development Index	0.6398	0.1469	0.0000	0.6426	0.6747	0.7029	0.8492

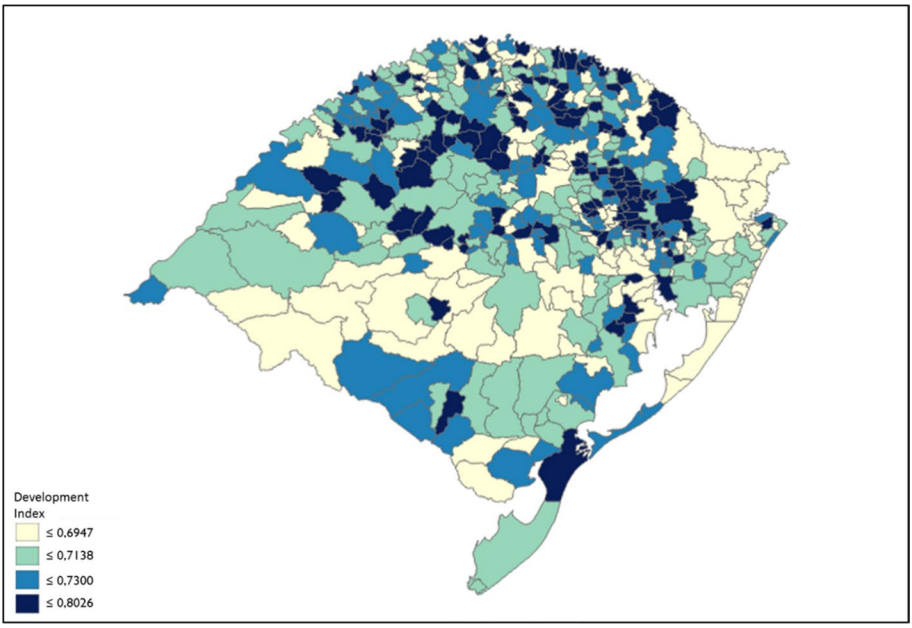

Fig. 1 Geographical distribution of the development index in 2016. Source: Authors' estimation

Thus, the models were specified to estimate the effects of public expenditure on multidimensional development indices and constructed sub-indices, while controlling the influence of the lagged dependent variable, time-invariant unobservable variables, and a set of control variables, based on a superior estimation methodology commonly used in dynamic panels. The models were estimated using the `xtdpdqml` command in Stata, developed by Kripfganz (2016).

4 Results

For the period considered in the study, the average estimated development index for the municipalities was 0.6398, with 75% of the municipalities showing results ranging from 0.6426 to 0.8492, and only 25% presenting an index larger than 0.7029 (see Table 3). In Fig. 1 the map shows a moderate pattern in terms of spatial distribution, with the northern half of the state presenting a higher proportion of municipalities with high rates of development in 2016. This observed spatial pattern for the development index is accompanied by the *per capita* expenditure, that is, there is a concentration of municipalities with the higher expenditure in the northern half of the state, as shown in Fig. 2.

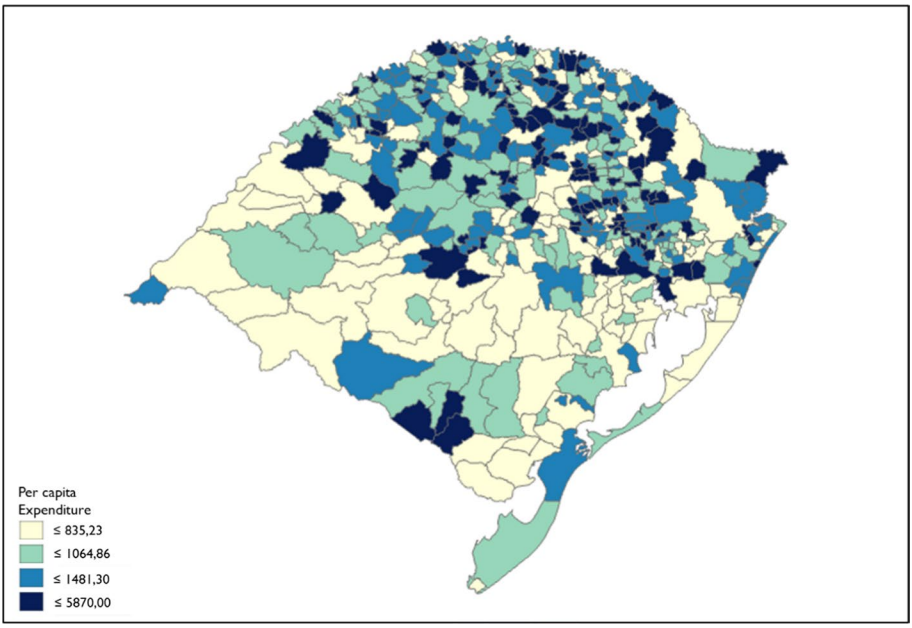

Fig. 2 Geographic distribution of *per capita* expenditure in 2016 (R$). Source: Authors' estimation

A comparison between the spatial patterns of the development index and the *per capita* expenditure may suggest some matters for consideration. On the one hand, more developed municipalities tend to have higher revenues and, therefore, greater investment capacity. This hypothesis shows the probable endogeneity between the variables and reinforces the need to use dynamic models. On the other hand, it can be concluded that expenditure in the state budget does not compensate for this tendency. This hypothesis, coupled with that of the effective impact of public expenditure on development, may suggest the existence of opportunities for improvement in people's living conditions through the spatial reallocation of the state budget.

Models with different expenditure time lags were tested, and those with significant effects are shown in Table 4. Specifying more than one time lag in the same model generates serial correlation problems and therefore cannot be performed. We also tested all the collected control variables, and each of the selected models was adjusted using the AIC and BIC criteria and serial correlation tests.

In line with the results of Torres (2012) and Martins and Veiga (2014), Model 1 shows public expenditure has positive and statistically significant effects on the development index. Models 2, 3 and 4 aim to explore the influence of public expenditure considering different time lags, and indicate the consistently positive effects of public investment, confirming the hypothesis that the effects persist beyond the period in which the change in expenditure occurs. More than this, the coefficients can be seen to gain greater magnitude as the lag increases and reaches its highest value at $t-3$. This conclusion contrasts with that of Torres (2012), who finds lagged expenditure has no effect on the index, but that study uses the ordinary least squares method, which is not robust for estimate dynamic panels.

Table 4 Results of models 1, 2, 3 and 4 development index. *Source*: Authors' estimations

	Model 1	Model 2	Model 3	Model 4
L.DevI	0.494*** (0.0147)	0.530*** (0.0188)	0.490*** (0.0213)	0.443*** (0.0243)
popfem	0.00196*** (0.000580)	0.00173** (0.000567)	0.00180** (0.000614)	0.00166** (0.000639)
pop15	− 0.00371*** (0.000227)	− 0.00293*** (0.000242)	− 0.00293*** (0.000258)	− 0.00248*** (0.000279)
Enpriv	0.000882** (0.000292)	0.00116*** (0.000320)	0.00139*** (0.000364)	0.00156*** (0.000414)
gc1000	0.00240*** (0.000474)			
L.gc1000		0.00295*** (0.000506)		
L2.gc1000			0.00405*** (0.000588)	
L3.gc1000				0.00592*** (0.000748)
N	3777	3449	3123	2783

Standard error in parentheses

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Martins and Veiga (2014), who do not explore the influence of lagged expenditure, use a nonlinear model to explore the quadratic effects of expenditure on the HDI. In contrast to our approach, the methodological approach used in their study does not allow this type of modeling, which is minimized by the authors' own conclusion that this behavior is only present among the developed countries.

The development index is further positively influenced by the percentage of women and the percentage of enrollments in private institutions in all the estimated models. As will be discussed in the next section, the percentage of women positively affects the knowledge element, and the enrollment rate in private institutions is associated with an improvement in the standard of living. Another variable negatively associated with development is higher percentages of the population aged under 15 years, meaning a lower proportion of the population being economically active, affecting income.

As with Hu et al. (2017), Mello and Pisu (2009) and Ssozi and Amlani (2015), the initial socioeconomic condition, represented in the models by the one-period lagged development index, is the main determinant of the present status. It is recognized that more affluent and educated families contribute to the expansion of the capability set of their members, reproducing the pattern of development through financial support, stimuli for cognitive and socioemotional development, and healthy habits.

Environments in which families are poorer and more vulnerable tend to repeat the low pattern of development through lower investments in children and young people, offering worse home care, lack of early childhood education, as well as conditions that do not foster development (Gupta & Simonsen, 2010).

The other variables tested were not significant and were removed to improve the fit of the models. The smoothing applied to the population estimates, and consequently the population density, may to some extent explain why these variables present no effects, especially since it concerns models estimated in first-difference.

4.1 Effects of Expenditure on the Sub-indices

The adopted methodological strategy sought to assess the effects of expenditure on the multidimensional development index. The choice is justified insofar as the socioeconomic dimensions are interdependent, and, therefore, assessments of specific sectors tend to underestimate the impact of government action. With this limitation in view, but with the objective of obtaining more subsidies for the analysis, models were specified to assess the effects on the constructed sub-indices. The results are displayed in Table 5.

As indicated by a large part of the empirical literature, the estimates show public expenditure has positive effects on all the sub-indices, but with different time lags. A positive change in public investment would positively affect the knowledge dimension within the period of the allocation of source, while the effects on the standard of living and longevity of the population would appear after two and three years, respectively. These findings are new in relation to previous studies, which generally do not include the time lag in their analyses. The results are in addition to those from Baldacci et al. (2008) that indicate expenditure impacts educational indicators for up to ten years after the change.

A higher proportion of young people up to fifteen years of age is negatively associated with all the studied dimensions. This finding seems to make sense since the smaller proportion of the economically active population tends to reduce income, and on the other hand, the younger the population, the greater is the burden of mortality in the potential years of life lost. Further study would be necessary to understand the channels that cause the effects to be negative also in the sub-index knowledge—which is a result that was also reported by Baldacci et al. (2008) and Gupta et al. (2002) for some educational indicators.

Table 5 Results of the models Standard of living, knowledge and longevity. *Source*: Authors' estimations

	Model 5 standard of living	Model 6 knowledge	Model 7 longevity
Lagged dependent variable	0.835*** (0.0198)	0.528*** (0.0145)	0.0605*** (0.0170)
pop15	− 0.000903*** (0.000219)	− 0.00164*** (0.000278)	− 0.00174*** (0.000399)
popfem	–	0.00269** (0.000837)	–
Infed	0.00202*** (0.000408)	–	–
Inpriv	0.00109*** (0.000298)	–	–
bfv	5.06e−09*** (1.42e−09)	–	–
gc1000	–	0.00201** (0.000714)	–
L2.gc1000	0.00294*** (0.000404)	–	–
L3.gc1000		–	0.00262** (0.000911)
N	4404	4224	4464

Standard error in parentheses

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

In addition, a higher percentage of women in the population is positively associated with the sub-index knowledge, a result aligned with those of Baldacci et al. (2008).

The variables collected to control federal public expenditure appear to positively influence the standard of living. While the effects of the BFP (*Bolsa Familiar* Program) income transfers are direct, the rate of enrollment in federal institutions can exert influence both by increasing the productivity of their students and by the above-average salaries of their employees. The same hypothesis is valid for the percentage of enrollments in private institutions. Regarding the BFP, specifically, it is worth noting that it has only significantly influenced the standard of living. This result stands out since one of the effects expected of conditional income transfer programs is the reduction of school dropout rates (Adato & Hoddinnott, 2010).

The lagged dependent variable obtains the highest coefficient in Model 5, suggesting that the intertemporal effect is greater on income than on the other studied dimensions. Despite having a significant and relevant effect, the lagged variable 'potential years of lost life' has a very small effect compared to the other dimensions. This behavior suggests the longevity dimension is stable in the municipalities of the state of Rio Grande do Sul, which contrasts with the findings of Ssozi and Amlani (2015) for the sub-Saharan African countries due to differences in the development stage of the analyzed localities.

So, our estimates consistently suggest that there are positive effects on the development of municipalities at different time periods. The methodological strategy is shown to be adequate, given the importance of the intertemporal analysis of the coefficients and the initial condition, that is, of the lagged dependent variables in explaining the variations.

4.2 Magnitude and Diminishing Returns on Expenditure

All the results point to public expenditure having positive and statistically significant effects on the development of municipalities, in line with much of the recent empirical literature. At this point, it would be of interest to discuss the magnitude of the estimated coefficients. An analysis of the coefficients in the seven models indicates an increase in expenditure of R$ 1000.00 *per capita*, which would mean an average increase of 27%, leads to increments ranging from 0.2% (Model 1) to 0.6% (Model 4) in the results.

In order to investigate the existence of diminishing returns, the models were re-estimated from a base composed exclusively of the observations in which the *per capita* expenditure is below the median. Table 6 shows the coefficients obtained for the complete

Table 6 Relative returns on *per capita* expenditure. *Source*: Authors' estimations

	Coef. full sample (a)	Coef. below the median (b)	(b)/(a)
Model 1—Development Index	0.0024	0.0027	1.13
Model 2—Development Index	0.003	0.004	1.33
Model 3—Development Index	0.0041	0.0071	1.73
Model 4—Development Index	0.0059	0.0131	2.22
Model 5—Element standard of living	0.0029	0.0081	2.79
Model 6—Element knowledge	0.002	0.0032	1.60
Model 7—Element longevity	0.0026	0.004	1.54

sample (column (a)) and for the base limited to the first half of the distribution (column (b)).

As in Mello and Pisu (2009) and Martins and Veiga (2014), we can see an increase in the effect when the level of expenditure is lower, which confirms the hypothesis of diminishing marginal returns. The coefficient is 2.7 times higher in Model 5, which estimates the impact on the standard of living. The limitations of the sample make it impossible to analyze the expenditure decile, or even assess the heterogeneity of effects according to developmental range.

4.3 Comparing the Results Obtained by QML and GMM

The methodological strategy was defined to enable the use of lagged dependent variables, and to control the time-invariant observable and unobservable variables. These conditions directed the study to the specification of dynamic panels with fixed effects, for which the preponderant estimation technique adopted in the literature is the GMM. The literature review indicates that the technique used here, QML estimation, offers advantages over the previous one. Thus, to provide a robustness comparison an to offer an additional empirical contribution, the seven models were re-estimated using GMM and then compared to the QML estimates. The results are displayed in Table 7.

As can be observed, the GMM estimation confirms the robustness of the obtained results, since the coefficients have the same signs and similar magnitudes. However, it is important to observe that in six of the seven models, the QML estimator is more efficient, that is, it presents smaller standard errors, which confirms the results in the previous empirical literature and the correctness of the choice of method.

5 Final Remarks

The results show public expenditure had a consistently positive and statistically significant effect on development. In addition, it was possible to conclude that these effects persist over time, peaking in magnitude three years after the change in expenditure. The disaggregation of the models into sub-indices allowed us to observe the differences in the relationship between expenditure and other control variables with the three

Table 7 Coefficients and standard errors of the models estimated using QML and GMM. *Source*: Authors' estimations

	QML			GMM		
	Coefficient	Standard error	Error/coefficient	Coefficient	Standard error	Error/coefficient
Model 1	0.0024	0.0006	0.25	0.0013	0.0007	0.54
Model 2	0.003	0.0005	0.17	0.0026	0.0006	0.23
Model 3	0.0041	0.0006	0.15	0.0032	0.0007	0.22
Model 4	0.0059	0.0007	0.12	0.0066	0.001	0.15
Model 5	0.0029	0.0004	0.14	0.0028	0.0008	0.29
Model 6	0.002	0.0007	0.35	0.003	0.0012	0.40
Model 7	0.0026	0.0009	0.35	0.0029	0.0004	0.14

dimensions of the index. While a change in expenditure affects the sub-index knowledge in the same year that it occurs, it takes two years to affect the standard of living and three years to have an effect on the longevity in the municipalities.

But if the results were sufficiently robust in terms of sign and significance, the estimated magnitude of the effects of expenditure was relatively low. On average, a 27% increase in *per capita* expenditure causes variations of between 0.2% and 0.6% in the indices. These effects are not linear, and are 2.7 times higher among municipalities that are below the median in terms of volume of *per capita* expenditure, suggesting diminishing returns. The limited nature of the sample means it is impossible to separately assess those municipalities with the lowest levels of expenditure or development. Hence, it is impossible to asses if the impact in the variation in expenditure becomes relevant for those localities.

In all the estimated models, the lagged dependent variable accounted for most of the variation in the index. These results are in line with the recent empirical literature and mean that the present the level of development measured by the index is a strong determinant of the future results. This intertemporal relationship is greater in the element 'standard of living' and reaches its minimum in the dimension 'longevity', which suggests the municipalities in RS are stable in relation to the 'potential years of life lost'.

The contribution of this work goes beyond the assessment/evaluation of the effects of expenditure on development in the state of Rio Grande do Sul, Brazil, since the methodological approach is unprecedented and provides advantages in relation to previous studies. The first of which is the establishment of a multidimensional index as a variable of interest, which enables a more complete measure of people's living conditions. Dynamic panels modeling, which enables control of the initial socioeconomic condition, fixed effects and a set of other variables, has rarely been employed for this purpose. In addition, the panels were estimated using QML, which is more efficient than the traditional method and again, scarcely represented in the empirical literature.

However, the study has some limitations. Despite the robustness of the methodology employed, the establishment of causal relations through non-experimental methods should be analyzed with caution due to possible time-invariant unobservable variables. In addition, the need to work with panel-based and municipal-based data limited the range of possible variables, either for the construction of the development index or for the control of exogenous effects in the model. Nevertheless, the consistency of the results from the different models suggests a good capacity to explain the relationships involved.

This study may give rise to public policy suggestions that favor development. An assessment of the spatial pattern of the development index and *per capita* expenditure, combined with the results obtained, suggests the possibility of increasing the effectiveness of expenditure through spatial redistribution, thus positively impacting people's living conditions.

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Declarations

Conflict of interest None.

References

Abdelkader, B., Cheikh, S., & Sofiane, M. (2017). The impact of the public expenditure on employment and income in Algeria: An empirical investigation Mostéfaoui. *American Journal of Economics, 7*(3), 155–161.

Adato, M., & Hoddinnott, J. (2010). *Conditional cash transfers in Latin America*. IFPRI Books.

Aisa, R., Clemente, J., & Pueyo, F. (2014). The influence of (public) health expenditure on longevity. *International Journal of Public Health, 59*(5), 867–875. https://doi.org/10.1007/s00038-014-0574-6

Allison, P., Williams, R., & Moral-Benito, E. (2017). Maximum likelihood for cross-lagged panel models with fixed effects. *Sociological Research for a Dynamic World, 3*, 1–17. https://doi.org/10.1177/2378023117710578

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies, 58*(2), 277–297. https://doi.org/10.2307/2297968

Bahaddi, T., & Karim, M. (2017). Impact of public expenditure on the growth in Morocco: Role of governance. *International Journal of Economics and Finance, 9*(4), 12–19.

Balaj, D., & Lani, L. (2017). The impact of public expenditure on economic growth of Kosovo. *Acta Universitatis Danubius. Œconomica, 13*(5), 401–412.

Baldacci, E., Clements, B., Cui, Q., & Gupta, S. (2008). Social spending, human capital, and growth in developing countries. *World Development, 36*(8), 1317–1341. https://doi.org/10.1016/j.worlddev.2007.08.003

Benedict, U. A., Efefiom, E. C., & Ochagu, O. O. (2016). Economic growth of West African Countries and the Validity of Wagner's law: A panel analysis. *Asian Journal of Economics and Empirical Research, 3*(1), 71–83.

Braatz, J. (2016). *O que explica a deterioração recente das finanças públicas do RS e quais são as perspectivas*. Secretaria da Fazenda do Rio Grande do Sul. Texto para Discussão n. 01/2016, Porto Alegre, 2016. Disponível em. Retrieved March 22, 2018, from https://tesouro.fazenda.rs.gov.br/lista/4098/textos-para-discussao

Butkiewicz, J. L., & Yanikkaya, H. (2011). Institutions and the impact of government expenditure on growth. *Journal of Applied Economics, 14*(2), 319–341. https://doi.org/10.1016/S1514-0326(11)60017-2

Cchingoiro, S., & Mbulawa, S. (2016). Economic growth and infrastructure expenditure in Kenya: A Granger-Causality approach. *International Journal of Social Science Studies, 4*(9), 1–8. https://doi.org/10.11114/ijsss.v4i9.1749

Churchill, S. A., Ugur, M., & Yew, S. L. (2017). Does government size affect per-capita income growth? A hierarchical meta-regression analysis. *Economic Record, 93*(300), 142–171. https://doi.org/10.1111/1475-4932.12307

Coleman, J., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfedl, F. D., & York, R. L. (1966). *Equality of educational opportunity* (p. 749). U.S. Department of Health, Education & Welfare Office of Education.

Cruz, A. C., Teixeira, E. C., & Braga, M. J. (2010). Os efeitos dos gastos públicos em infraestrutura e em capital humano no crescimento econômico e na redução da pobreza no brasil. *Revista Economia, 11*(4), 163–185.

Dalis, T. D., Likita, J. O., & Abekya, J. J. (2017). Public expenditure and human capital development in Nigeria. *International Journal of Management Science Research, 3*(7), 144.

Dastidar, G. S., & Cchatterji, M. (2015). *Public expenditure in different education sectors and economic growth: The Indian experience.* MPRA Paper, n. 66903. Retrieved December 20, 2018, from https://mpra.ub.uni-muenchen.de/66903

Dogan, E., & Tang, T. C. (2006). Government expenditure and national income: Causality tests for five south east Asian countries. *International Business & Economics Research Journal, 5*(10), 49–58. https://doi.org/10.19030/iber.v5i10.3516

Gardner, J. W., & Sanborn, J. S. (1990). Years of potential life lost (YPLL)—What does it measure? *Epidemiology, 1*(4), 322–329. https://doi.org/10.1097/00001648-199007000-00012

Gupta, N., & Simonsen, M. (2010). Non-cognitive child outcomes and universal high quality child care. *Journal of Public Economics, 94*(1–2), 30–43. https://doi.org/10.1016/j.jpubeco.2009.10.001

Gupta, S., Verhoeven, M., & Tiongson, E. R. (2002). The effectiveness of government expenditure on education and health care in developing and transition economies. *European Journal of Political Economy, 18*(4), 717–737. https://doi.org/10.1016/S0176-2680(02)00116-7

Hakooma, M. R., & Seshamani, V. (2017). The impact of human capital development on economic growth in Zambia: An econometric analysis. *International Journal of Economics, Commerce and Management, 5*(4), 71–87.

Hanushek, E. A. (2013). Economic growth in developing countries: The role of human capital. *Economics of Education Review, 37*, 204–212. https://doi.org/10.1016/j.econedurev.2013.04.005

Hassan, S. U., & Mishra, B. (2017). Government expenditure and economic growth in the State of Jammu and Kashmir: A unit root and co-integration approach with error correction model. *International Journal of Statistics & Economics, 18*(2), 417–501.

Hsiao, C., Pesaran, H., & Tahmiscioglu, A. K. (2002). Maximum likelihood estimation of fixed effects dynamic panel data models covering short time periods. *Journal of Econometrics, 109*(1), 107–150. https://doi.org/10.1016/S0304-4076(01)00143-9

Hu, B. Y., Zhou, Y., Chen, L., Fan, X., & Winsler, A. (2017). Preschool expenditures and Chinese children's academic performance: The mediating effect of teacher-child interaction quality. *Early Childhood Research Quarterly*. https://doi.org/10.1016/j.ecresq.2017.05.002

Hussain, I., Khan, Z., & Rafiq, M. (2017). An empirical analysis of the impact of compositional changes in public expenditure on economic growth: Time series evidence from Pakistan. *Business & Economic Review, 9*(1), 1–20.

Idenyi, O. S., Ogonna, I. C., Chinyere, U. C., & Chbuzor, C. B. (2016). Public expenditure and economic growth in South Africa: Long run and causality approach. *Asian Journal of Economics, Business and Accounting, 1*(2), 1–17. https://doi.org/10.9734/AJEBA/2016/29677

Kripfganz, S. (2016). Quasi-maximum likelihood estimation of linear dynamic short-T panel-data models. *Stata Journal, 16*(4), 1013–1038. https://doi.org/10.1177/1536867X1601600411

Linden, M., & Ray, D. (2017). Life expectancy effects of public and private health Expenditures in OECD countries 1970–2012: Panel time series approach. *Economic Analysis and Policy, 56*, 101–113. https://doi.org/10.1016/j.eap.2017.06.005

Mallick, L., Das, P. K., & Pradhan, K. C. (2016). Impact of educational expenditure on economic growth in major Asian countries: Evidence from econometric analysis. *Theoretical and Applied Economics, 23*(2), 173–186.

Manamperi, N. (2016). Does military expenditure hinder economic growth? Evidence from Greece and Turkey. *Journal of Policy Modeling, 38*(6), 1171–1193. https://doi.org/10.1016/j.jpolmod.2016.04.003

Martins, S., & Veiga, F. J. (2014). Government size, composition of public expenditure, and economic development. *International Tax and Public Finance, 21*(4), 578–597. https://doi.org/10.1007/s10797-014-9313-4

Mello, L., & Pisu, M. (2009). *The effectiveness of education and health expenditure among Brazilian municipalities*. OECD Economics Department Working Papers, 712, OECD Publishing, Paris.

Moral-Benito, E. (2013). Likelihood-based estimation of dynamic panels with predetermined regressors. *Journal of Business & Economic Statistics, 31*(4), 451–472. https://doi.org/10.1080/07350015.2013.818003

Musgrave, R. A. (1985). A brief history of fiscal doctrine. In *Handbook of public economics*. Elsevier Science Publishers B. V. https://doi.org/10.1016/S1573-4420(85)80004-5

Nurudeen, A., & Usman, A. (2010). Government expenditure and economic growth in Nigeria, 1970–2008: A disaggregated analysis. *Business and Economics Journal, 4*, 1–11.

Okanta, S. U., & Idika, J. E. (2017). An Analysis of government social expenditure and their correlation with social outcomes in Nigeria: Focus on education. *International Journal of Banking and Finance Research, 3*(3), 1–12.

Organisation for Economic Co-operation and Development., European Commission., & SourceOECD (Online service). (2008). *Handbook on constructing composite indicators: Methodology and user guide*. OECD.

Perloff, J., Lebailly, S., Kletke, P., Budetti, P., & Connelly, J. (1984). Premature death in the United States: Years of life lost and health priorities. *Journal of Public Health Policy, 5*(2), 167–184. https://doi.org/10.2307/3342337

Petry, G., Braatz, J., & Martinez, P. (2018). *Textos para discussão: Perspectivas para as finanças públicas do RS no período de 2019 a 2025*. Secretaria da Fazenda do Rio Grande do Sul, Porto Alegre, 2018. Retrieved March 22, 2018, from https://tesouro.fazenda.rs.gov.br/lista/4098/textos-para-discussao

Phillips, R. (2018). Quasi maximum-likelihood estimation of dynamic panel data models. *Communication in Statistics - Theory and Methods, 47*(16), 3970–3986. https://doi.org/10.1080/03610926.2017.1366521

Robeyns, I. (2005). The capability approach: A theoretical survey. *Journal of Human Development, 6*(1), 94–114. https://doi.org/10.1080/146498805200034266

Romeder, J. M., & Mcwhinnie, J. R. (1977). Potential years of life lost between ages 1 and 70: An indicator of premature mortality for health planning. *International Journal of Epidemiology, 6*(2), 143–151. https://doi.org/10.1093/ije/6.2.143

Santos, C., Almeida, V., Caldas, L., Sa, J. H., Machado, U., Martins, F., & Brito, A. (2017). A dinâmica do déficit dos regimes próprios de previdência dos estados brasileiros nos anos 2006–2015. *Carta De Conjuntura IPEA, 34*, 123–154.

Sen, A. (1985). *Commodities and capabilities*. North Holland.

Sen, A. (1999). *Development as freedom* (p. 384). Oxford University Press.

Ssozi, J., & Amlani, S. (2015). The effectiveness of health expenditure on the proximate and ultimate goals of healthcare in Sub-Saharan Africa. *World Development, 76*, 165–179. https://doi.org/10.1016/j.worlddev.2015.07.010

Stiglitz, J. (1986). *Economics of the public sector* (p. 960). W.W. Norton & Company.

Torres, M. C. R. (2012). Incidencia del gasto público social en el índice de desarrollo humano en Bogotá, 1995–2010. *Equidad y Desarrollo, 17*, 57–85.

Torruam, J. T., & Abur, C. C. (2014). Public expenditure on human capital development as a strategy for economic growth in Nigeria: Application of co integration and causality test analysis. *International Journal of Research in Humanities and Social Studies, 1*(2), 14–23.

Torruam, J. T., Chiawa, M. A., & Abur, C. C. (2014). Cointegration analysis of public expenditure on tertiary education and economic growth in Nigeria. *CBN Journal of Applied Statistics, 5*(2), 137–146.

UNDP – United Nations Development Program. (1990). *Human development report 1990*. UNDP.

Uzuner, G., Bekun, F. V., & Akadiri, S. S. (2017). Public expenditures and economic growth: Was Wagner right? Evidence from Turkey. *Academic Journal of Economic Studies, 3*(2), 36–40.

Van Den Heuvel, W. J. A., & Olaroiu, M. (2017). How important are health care expenditures for life expectancy? A comparative, European analysis. *Journal of the American Medical Directors Association, 18*(3), 276.e9-276.e12. https://doi.org/10.1016/j.jamda.2016.11.027

Williams, R., Allison, P., & Moral-Benito, E. (2018). Linear dynamic panel-data estimation using maximum likelihood and structural equation modeling. *The Stata Journal, 18*(2), 293–326. https://doi.org/10.1177/1536867X1801800201

Wu, S., Tang, J., & Lin, E. S. (2010). The impact of government expenditure on economic growth: How sensitive to the level of development. *Journal of Policy Modeling, 32*(6), 804–817. https://doi.org/10.1016/j.jpolmod.2010.05.011

Yovo, K. (2017). *Public expenditure and economic growth in Togo***.** African Economic Research Consortium Research, Paper 331, 2017.