

## Research Article

Individual microentrepreneurs and economic development  
in the municipalities of São Paulo from 2010 to 2014Lawton Nanni Benatti<sup>AB\*</sup> , Edimilson Eduardo da Silva<sup>C</sup> , and Leandro Campi Prearo<sup>A</sup> <sup>A</sup> Municipal University of São Caetano do Sul, USCS, São Caetano, SP, Brazil<sup>B</sup> Technology Faculty of Santana de Parnaíba, FATEC, Santana de Parnaíba, SP, Brazil<sup>C</sup> Federal University of Vales do Jequitinhonha e Mucuri, UFVJM, Diamantina, MG, Brazil

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## Abstract

**Study Aims:** To analyze the significant relationship contribution of Individual Microentrepreneurs (MEI) in the socioeconomic development of São Paulo municipalities in the period from 2010 to 2014. **Methodology:** Quantitative approach, of an explanatory nature, with documentary research on data from 637 municipalities in the state of São Paulo. Based on the studies by [Silva and Porto Júnior \(2006\)](#) and [Caldarelli and Perdigão \(2018\)](#), the Gross Domestic Product (Municipal GDP) and the Firjan Municipal Development Index (IFDM) were defined as dependent variables and the total of Existing MEIs per municipality. **Main results:** There were evidenced positive and significant coefficients of MEI's in 24 municipalities in São Paulo with low and medium socioeconomic growth, in 2014. **Methodological contributions:** Use of the Quantile Regression technique, more appropriate to estimate independent variables categorized by high variability, as demonstrated in the studies by [Hao and Naiman \(1949\)](#), [Santos \(2012\)](#), [Das, Krzywinski, and Altman \(2019\)](#) and [Koenker and Hallock \(2001\)](#). **Relevance and originality:** The study expands, in part, the understanding of previous studies on the different relationships pointed out between the MEI, the GDP and the IDFM of municipalities in different categories of municipal socioeconomic development. **Managerial contributions:** Public managers, from both small and medium or large cities, based on differentiated actions consistent with each context, have a policy of fostering and supporting the creation of micro and small businesses with one of the effective ways to enhance and impact socioeconomic development.

**Keywords:** Individual microentrepreneurs; Quantile regression; Economic development; Economic and social indicators; GDP and IFDM.

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## Resumo

**Objetivo:** Analisar a relação significativa da contribuição dos Microempreendedores Individuais (MEI) no desenvolvimento socioeconômico dos municípios paulistas no período de 2010 a 2014. **Metodologia:** Abordagem quantitativa, de natureza explicativa, com pesquisa documental em dados de 637 municípios do estado de São Paulo. Baseado nos estudos de [Silva e Porto Júnior \(2006\)](#) e [Caldarelli e Perdigão \(2018\)](#), definiu-se como variáveis dependentes o Produto Interno Bruto (PIB Municipal) e o Índice Firjan de Desenvolvimento Municipal (IFDM) e como variável independente o total de MEI's existentes por município. **Principais resultados:** Evidenciaram-se coeficientes estimados positivos e significativos dos MEI's em 24 municípios paulistas de baixo e médio crescimento socioeconômico, em 2014. **Contribuições metodológicas:** Uso da técnica de Regressão Quantílica, mais adequada para estimar variáveis independentes categorizadas por alta variabilidade, conforme demonstrada nos estudos de [Hao e Naiman \(1949\)](#), [Santos \(2012\)](#), [Das, Krzywinski e Altman \(2019\)](#) e [Koenker e Hallock \(2001\)](#). **Relevância e originalidade:** O estudo amplia, em parte, a compreensão dos estudos anteriores sobre as diferentes relações apontadas entre o MEI, o PIB e o IDFM de municípios em diferentes categorias de desenvolvimento socioeconômico municipal. **Contribuições gerenciais:** Os gestores públicos, tanto de municípios de pequeno quanto de médio e grande porte, a partir de ações diferenciadas e coerentes com cada contexto, têm a política pública de fomento e de apoio à criação de micro e pequenos negócios com um dos caminhos efetivos para potencializar e impactar o desenvolvimento socioeconômico.

**Palavras-Chave:** Microempreendedores individuais; Regressão quantílica; Desenvolvimento econômico; Indicadores econômicos e sociais; PIB e IFDM.

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## INTRODUCTION

Local economic development is the focus of study and a public policy concern, particularly associated with the entrepreneurship of small businesses that usually meet this demand with the municipalities. In emerging or underdeveloped countries, the literature further highlights this situation due to the limitations existing in these markets. Even for developed countries, municipalities with lower income power or poorer neighborhoods also usually benefit from the development that small businesses allow for such geographic cuts (Houston and Reuschke, 2017; Canever et al., 2010; Bateman, 2000; Zvarych, 2017; Poliattykina and Samoshkina, 2018).

However, informality in micro-businesses is a public issue. (Silva, Fonseca and Santos, 2016; Hallak and Ramos, 2014). The creation of alternatives by the public authorities for the business formalization or even meeting the need for business creation in environments with high unemployment and low economic development is a social demand and, in Brazil, the figure of the Individual Microentrepreneur - MEI is formalized through of Complementary Law 128 of 2008, allowing individual entrepreneurs to now act formally as a legal entity. Easy to manage and low taxation, it allows a large part of informal entrepreneurs to migrate to formality and act within the law.

To understand the effects of the relationship widely discussed in the literature between economic development and small business entrepreneurship, it is interesting to define indicators that allow, in quantitative terms, to observe the phenomenon. The literature defines the Gross Domestic Product (Municipal GDP) and the Firjan Municipal Development Index (IFDM), as indicators that make it possible to observe the relationships of both economic development (GDP) and local development (IFDM).

The aim of this paper is to analyze the relationship between the total number of Individual Microentrepreneurs (MEI) in the different quantiles of the conditional distribution of the indicators of socioeconomic development Gross Domestic Product (Municipal GDP) and Firjan Municipal Development Index (IFDM) of the São Paulo State municipalities in the period of 2010 to 2014.

The objective of this work, then, is to study the relationship between the total number of Individual Microentrepreneurs (MEI), in the different quantiles of the conditional distribution of socioeconomic development indicators (Municipal GDP and IFDM), from São Paulo municipalities, in the period from 2010 to 2014.

The time frame used considered the results obtained by crossing the existing total MEI and the GDP and IFDM indicators, based on data from the Brazilian Micro and Small Business Support Service (Data Sebrae), from the Brazilian Institute of Geography and Statistics (IBGE) and the Unified Health System of the Ministry of Health (Datasus). It is worth mentioning that the databases, in studies related to small businesses, are repeatedly compromised by the difference in time frames and according to the complete availability of the data.

This study is justified: (a) by the relevance of the theme, considered a worldwide concern, according to the existing literature, particularly in emerging or underdeveloped countries, and in peripheral regions of large cities or poorer municipalities, in developed countries, contributing, thus, for the economic analysis of the effects of this relationship; (b) because the works that make up the literature on MEI are still rare: on the Scielo article portal, for example, when using related keywords, such as "individual microentrepreneur"

and "individual microentrepreneur", only three results were pointed out. Although there are other databases, with indexed articles, this result already reinforces the need for studies on the segment; and (c) São Paulo cities, which constitute the largest national GDP, concentrating almost one third of all the wealth produced in 2018 (32.68%) (IBGE, 2020), are scenarios that favor research and deserve to be studied through the relationship between the phenomena highlighted here.

As a statistical method, quantile regression was considered the most appropriate statistical technique to estimate independent variables categorized by high variability, containing independent variables with a high degree of dispersion in dimensions of size, wealth and population and, with quantile regression, it is allowed that the phenomenon is observed through the different quantiles (Hao and Naiman, 1949; Santos, 2012; Das, Krzywinski and Altman, 2019; Koenker and Hallock, 2001).

This article is structured with the theoretical framework addressing economic development and development indicators, covering the international literature on the subject and deepening in detail on GDP and on IFDM and subsequently presents details on the figure of the Individual Microentrepreneur - MEI. Then, it presents the methodological procedures related to the application of the quantile regression technique including the treatment of the data and continues with its application and analysis. Finally, the final considerations are presented based on the observation of the results of the studied phenomenon.

Detailing	Content
<b>Objective</b>	Analyze the relationship between the total number of Individual Microentrepreneurs (MEI), Gross Domestic Product (Municipal GDP) and Firjan Municipal Development Index (IFDM)
<b>Study Objective</b>	Municipalities of São Paulo State
<b>Time Frame</b>	2010 to 2014
<b>Sample Size</b>	637 municipalities out of a total of 645 municipalities from São Paulo State, eight municipalities being excluded due to lack of data
<b>Methodology</b>	Quantitative approach, using the multivariate technique Quantile Regression
<b>Independent Variable</b>	Per capita Individual Microentrepreneurs (MEI)
<b>Dependent Variables</b>	Municipal GDP Per capita Municipal IFDM

**Tab. 01**

Summary table of the article

**Source:** Elaborated by the authors.

To facilitate the understanding of the studied scope, [Table 1](#) shows the methodological summary of the research, with the sample identification, allowing greater objectivity of the analysis. The depth of each aspect will be described, next, in the section on methodological procedures.

## ECONOMIC DEVELOPMENT AND DEVELOPMENT INDICATORS

The relationship between entrepreneurship, especially of micro and small businesses, with local economic development is largely supported by the literature and, in general, the concern with this theme in developing countries is even greater. Canever et al., (2010), when observing the relationship between the stimulus of the factors that determine the creation of companies, demonstrated a direct influence on the per capita income and on the human development index, although they emphasize that

the local economic development is the result of a combination of factors. In general, public policies for regional and local development work within a set of stimuli that reflect the local reality and the circumstances of regional daily life (Sawaya, 2006).

Social development is directly related to economic development policies, especially on the local or municipal issue, since the population in general perceives the reflexes of policies in their sphere of close coexistence, such as Barros and Pereira (2008) also reinforce the benefits of economic and social development through the efforts of entrepreneurship.

Sustainable development associated with local development policies, within the scope of the framework of social inequalities and reinforced by the sustainability tripod - environment, economy and people - must be a guiding factor for public policies. Looking broadly, local development must take into account the local characteristics and specificities of each municipality and the region where it is located, whether cultural, geographical or environmental. It is also considered that local development goes beyond economic growth, thinking about the quality of life of its inhabitants as a reference, in addition to the issue of environmental conservation, as presented by Macêdo and Cândido (2011).

The literature review shows that developing countries, but not exclusively, realize that the stimulus to local development of small businesses contributes to the phenomenon of decreasing social inequality and, particularly within the cutout of this study, the improvement of social and economic development indicators. Even in developed countries, the focus on small businesses for local development occurs especially in peripheral neighborhoods of large cities and cities with lower development indicators, which highlights the international relevance of the topic.

Bateman (2000) addresses the relevance of supporting small businesses as part of the process of economic development in Eastern Europe and post-communist Central Europe, just as Servon et al., (2010) also focus on municipal development and the challenges related to public policies in support of micro-business in New York City.

McFarland and McConnell (2012) relate the role of municipal public policies in supporting small businesses during periods of recession in the United States and report on the multiple dimensions that small businesses have, as there is a diversity of sizes, activities and motivations for these businesses. Elmedni, Christian, and Stone (2018), in a study in New York City, even point out efforts to support local business development, especially for peripheral neighborhoods in municipalities as part of public policies aimed at economic development. In all the situations studied, social development is inherent to the process as part of the expected reflexes of economic development, given the focus of action on the peripheries.

Houston and Reuschke (2017), with a focus on the United Kingdom, also reinforce the relationship between the economic development of cities and micro businesses, although the study presents a gap in the increase of jobs in this section of legal action, but are nevertheless relevant to the understanding of the development of cities.

Zvarych (2017) comments on the relationship between local economic development and the influence of small businesses in this process in Ukraine, like Poliatykina and Samoshkina (2018), also focusing on the same country, address the issue of small business support as part of the economic development solution.

Karanina et al., (2017) strengthen the role of small businesses in the economy, especially in developing countries, by presenting the methods and tools adopted by developed countries in support of small businesses with the survey of information on the European Union, United States, Japan, China and Singapore.

Vorobyeva (2018) states that small businesses in Russia will be a focal point for social stabilization and local economic development.

For Holm (2017), when researching the role of incubators in the state of Georgia in the United States, the state's effort to stimulate small businesses through spaces for entrepreneurship enables efforts to develop innovation as the set of tools available in these spaces becomes unfeasible economically speaking for a single company, but, in a shared way, leverage all companies, particularly technology companies. Stimulating small technology businesses usually creates more competitive environments and strengthened companies.

Sánchez-García, Vargas-Morúa, and Hernández-Sánchez (2018), through the bibliometric study on well-being related to entrepreneurship, point out that the economic development of communities is directly related to entrepreneurship and point out that social entrepreneurship is also related to local development.

Even so, Park and Seo (2018) reflects about the need of small businesses to seek better results through strategic guidance because of the known problems of lack of resources and experience gaps in strategic planning of entrepreneurs. Behling and Lenzi (2019) also reinforce the relationships between the strategic competencies needed by entrepreneurs related to the social and economic environment in which their businesses operate and, particularly in developing countries, the limitations in this regard are common. Moreover, the problem of the lack of structure and management of small businesses is known and contributes to high rates of early mortality (Benatti, 2016).

It is important that economic development related to the presence of small businesses be measurable and, through the indicators that allow observing economic phenomena within their context, it is possible to identify the correlations.

The Gross Domestic Product - GDP, represents the sum of all goods and services that are produced by the country, state or even the municipality, considering the final goods and services to avoid recounting. Generally confused with the wealth of a nation, it actually represents the production within a certain period of time, which shows, within that time cut, if the production was greater or lesser. Almeida, Valadares, and Sediayama (2017) deal with the relationship between the GDP and the economic growth of Brazilian states as a way of observing the relationship between small business entrepreneurship and other determining factors.

According to IBGE (2020), GDP is composed of the consolidation of several indicators, including information on the family budget, prices and retail development, the trade balance, among others.

With GDP, it is possible to observe the evolution of production, as well as to make comparisons between economies of different countries, despite the limitations of phenomena, such as quality of life and social inequality. Per capita GDP represents the division, in a uniform way, of all the wealth produced, in relation to its inhabitants, but my criterion does not take into account the existing social differences.

The use of GDP for association with a public interest indicator has already been done by [Marioni et al., \(2016\)](#) when proposing to evaluate the impact of the National Program for the Strengthening of Family Agriculture - Pronaf on the GDP of the Brazilian economy.

As an indicator capable of analyzing local development, the Firjan Municipal Development Index (IFDM), built on the basis of official public statistics, published by the Ministries of Labor, Education and Health, allows annual monitoring of improvements in more than 5,000 Brazilian municipalities, resulting from public policies adopted in three areas of activity: employment and income, education, and health ([Firjan, 2018](#)).

With a variation from 0 (minimum) to 1 (maximum), the indicator classifies through a national ranking the relative position of the municipalities into four categories: low (from 0 to 0.4), regular (0.4 to 0.6), moderate (from 0.6 to 0.8), and high (0.8 to 1) development, with the closer the indicator gets to 1, the greater the development of the locality. The IFDM minimizes the distortions of social inequality observed in an analytical manner in the GDP by addressing the local focus, generally closer to the reality of municipalities, although it does not definitively distance the problem of social differences.

With the use of IFDM to analyze the economic development associated with small businesses, it is possible to understand its relationship with factors, such as employment and income. By this index, as a reference, [Cócaro, Cardoso and Pereira \(2016\)](#) evaluated the territories of citizenship in the state of Mato Grosso, and among the aspects pointed out for the reduction of social inequality, the improvement of the productive capacities of small businesses is highlighted significantly. [Caldarelli and Perdigão \(2018\)](#) also use IFDM as a variable for the analysis of socioeconomic development in the Center-South region of Brazil.

## INDIVIDUAL MICROENTREPRENEURS (MEI)

The Individual Microentrepreneur (MEI) represents the formalization of the self-employed professional as a legal person, with access to various facilities that only regularly constituted companies have, such as: opening a current account, loans and direct purchases from suppliers, among other rights (and obligations) of a formal business.

Many professionals, until then with irregular performance and in precarious situations, typically associated with informality, started to form a company, based on the National Register of Legal Entities (CNPJ) received after being framed in the MEI. All the facilities granted are provided for by law, and this effort, in addition to Brazil, includes countries such as Colombia, China, India and Chile - a situation that is repeated in many economies in emerging or underdeveloped countries, according to [Vergara-Mesa et al., \(2017\)](#).

There is a strong similarity between the figure of the individual micro-entrepreneur and the literature on fostering micro-business as described by [Houston and Reuschke \(2017\)](#), [Servon et al., \(2010\)](#). Micro-businesses represent the path found by the State for the formalization of informal productive activities of entrepreneurs or families, previously isolated in their economic activities without support or recognition from public authorities for not formally existing.

Formalizing economic activity contributes to improving the quality of life of microentrepreneurs and their families, since many use the labor of spouses and children in productive activities, as [Silva et al., \(2016\)](#) warn.

[Silva and Porto Júnior \(2006\)](#) speak about the impact that the informal economy or for own consumption affects the economic and social indicators, since the State cannot observe or even capture the volume of resources moved by this market, becoming invisible by the official statistics, even if it is real through the eyes of the market.

In spite of the improvisation and the vision of the informal enterprising directed to the applied learning, as [Arantes, Freitag, and Santos \(2018\)](#) present, what is discussed in the article is the incapacity of the entrepreneurs to enjoy the benefits that the formal company possesses, either through the requirements of suppliers or even the legal guarantees foreseen in the legislation, at a low cost of maintenance of the formal condition, through the figure of MEI.

Complementary Law 123 of 2006, better known as the General Law of Micro and Small Enterprises, establishes the National Statute of Micro and Small Enterprises and, soon thereafter, is modified by Complementary Law 128 of 2008, which creates the figure of the Individual Microentrepreneur, followed by other complementary laws and resolutions that increase the annual revenue limit of MEI, currently by R\$81.000.00 within the period from January to December; simplifies several processes related to MEI, as well as unbureaucratizes the process of opening, documentation and payment of taxes, concentrating all management in a single access site to facilitate microentrepreneurs to comply with legal requirements.

With low tax burden and easy management, it allows a great part of informal entrepreneurs to act in a legal way as a legal entity, even if there is no satisfactory statistical data to follow this migration to formality, a problem already evidenced by [Hallak and Ramos \(2014\)](#).

MEI can act in industry, commerce and services, being predominant its performance in the last category and serve as a buffer mattress for unemployment with the recent changes in the labor market for the provision of services autonomously by professionals for large companies, despite the criticism of the so-called pejotization process that represents the performance of individuals as legal entities without the effective professional freedom many times concentrating the provision of services in a single company, as if it were "employed by it", as described by [Barbosa and Orbem \(2015\)](#).

Even so, the figure of MEI ends up exercising a social function by allowing entrepreneurs, previously restricted to informal activities, to act in a formal manner as a legal entity, even if there are limitations beyond the invoicing limit such as those provided for in Art. 18 of Law 128 of 2006, such as the exclusion of certain economic activities not provided for in the legislation, being a partner or owner of another company, owning more than one establishment or hiring more than a single employee with a remuneration limit of one minimum wage in effect or the base salary of the specific category of action of MEI.

The State of São Paulo concentrates the largest number of MEI's installed in Brazil, with a total of 1,171,464 MEI's registered in the 645 municipalities of the State according to data from Data Sebrae of 2014, being the capital São Paulo the city with the largest total of MEI's in Brazil responsible for 364,057 companies ([Data Sebrae, 2020](#)).

As it is the state with the greatest economic power in the Federation, seen as the country's economic thermometer, the geographic profile of São Paulo is relevant. Comparing its total number of companies with the sum of the total number



of companies in the other units of the Federation, São Paulo accounts for 31.57% of the total formal organizations in the country.

When correlating economic development with small businesses, particularly in the MEI's, it is important to have a previously studied model, which can be found in [Silva and Porto Júnior \(2006\)](#) that deals with this same approach when analyzing the supposed positive relationship between financial development and economic growth based on the use of per capita GDP and, for the purpose of this study, also aggregates the use of the Firjan Index to offer greater robustness to the results focused on the spectrum of municipal development.

The creation of the MEI was timely and there are strong indications that it was the form most used by citizens affected by unemployment in the Campos Basin region as a source of income replacement ([Gondim, Rosa and Pimenta, 2017](#)), and this reasoning has already been observed by [Barros and Pereira \(2008\)](#), when they report that Despite the healthy relationship between entrepreneurship and economic development and practically unanimity in academia, there is a strong relationship between unemployment and entrepreneurship, since when there is an increase in economic activity, there is a greater offer of employment and, consequently, entrepreneurial activity out of necessity becomes less necessary.

Entrepreneurship by necessity is understood as that motivated by the absence of business opportunities, often linked to the aspects of survival of families, not exclusively but recurring in emerging and underdeveloped countries or even in municipalities and neighborhoods of lower purchasing power in developed countries, while entrepreneurship by opportunity is motivated by the interest of growth, opportunity and the development of new business and productive activities, as described by [Amorós et al., \(2017\)](#).

It should also be noted that the public policies for the creation and implementation of MEI's, to contribute to local development, must be accompanied by public power and society in order to optimize the expected results, avoiding that this form of legal action is not very collaborative in the effort of economic development, such as the criticism made by [Campanha et al., \(2017\)](#), who observed in a municipality in the interior of the State of São Paulo fragile interorganizational relationships and more focused on individual interests than collective interests as the main focus that should be all public policy.

At the international level, the studies by [Canever et al., \(2010\)](#), observed relationships between business creation and per capita income and the human development index. [Houston and Reuschke \(2017\)](#), reinforced the relationship between the economic development of cities and micro businesses in the UK study.

There are studies demonstrating the influence of small businesses on local economic development in different countries such as Ukraine, European Union, United States, Japan, China, Singapore and Russia ([Zvorych, 2017](#); [Poliatykina and Samoshkina, 2018](#); [Karanina et al., 2017](#); [Vorobyeva, 2018](#)).

Empirical evidence presented above indicates that there is an association between socioeconomic indicators (GDP and IFDM) and Individual Microentrepreneurs (MEI) ([Karanina et al., 2017](#); [Poliatykina and Samoshkina, 2018](#); [Vorobyeva, 2018](#); and [Zvorych, 2017](#)). Therefore, and based on the theoretical framework studied, below ([Table 2](#)), are the hypotheses tested in this study.

It was chosen to analyze the quantiles 0.10, 0.25, 0.50, 0.75 and 90 because these strata represent the different levels of economic development, namely: low (q.10), medium low (q.25),

<b>Hypothesis (H1)</b>	Individual Microentrepreneurs (MEI) influence the GDP indicator of São Paulo municipalities in the quantile 10, ceteris paribus.
<b>Hypothesis (H2)</b>	Individual Microentrepreneurs (MEI) influence the GDP indicator of São Paulo municipalities in the quantile 25, ceteris paribus.
<b>Hypothesis (H3)</b>	Individual Microentrepreneurs (MEI) influence the GDP indicator of São Paulo municipalities at the quantile 50, ceteris paribus.
<b>Hypothesis (H4)</b>	Individual Microentrepreneurs (MEI) influence the GDP indicator of São Paulo municipalities at the quantile 75, ceteris paribus.
<b>Hypothesis (H5)</b>	Individual Microentrepreneurs (MEI) influence the GDP indicator of São Paulo municipalities at the quantile 90, ceteris paribus.
<b>Hypothesis (H6)</b>	Individual Microentrepreneurs (MEI) influence the IFDM indicator of São Paulo municipalities in the quantile 10, ceteris paribus.
<b>Hypothesis (H7)</b>	Individual Microentrepreneurs (MEI) influence the IFDM indicator of São Paulo municipalities in the quantile 25, ceteris paribus.
<b>Hypothesis (H8)</b>	Individual Microentrepreneurs (MEI) influence the IFDM indicator of São Paulo municipalities at the quantile 50, ceteris paribus.
<b>Hypothesis (H9)</b>	Individual Microentrepreneurs (MEI) influence the IFDM indicator of São Paulo municipalities at the quantile 75, ceteris paribus.
<b>Hypothesis (H10)</b>	Individual Microentrepreneurs (MEI) influence the IFDM indicator of São Paulo municipalities at the quantile 90, ceteris paribus.

**Tab. 02**

Tested Hypothesis

Fonte: Elaborated by the authors.

medium (q.50), medium high (q.75) and high (q.90). After the elaboration of the hypotheses, the methodological procedures were used.

## METHODOLOGICAL PROCEDURES

The research is characterized as explanatory and based on the technical procedures used, it fits as documentary. As for the approach, the data can be categorized as quantitative, which use numerical values to indicate quantity and use interval scale or ratio measurement ([Sweeney, Williams, and Anderson, 2013](#)).

Considering that the objective of the work is to analyze the relationship between the total of Individual Microentrepreneurs (MEI) in the different quantiles of the conditional distribution of socioeconomic development indicators Gross Domestic Product (GDP) and Firjan Index of Municipal Development (IFDM) of São Paulo municipalities in the period from 2010 to 2014, the methodological procedure takes into account the effects of this relationship. The analysis units correspond to the data referring to 637 of the 645 municipalities in the state of São Paulo, defining a priori the GDP, IFDM and MEI variables, from 2010 to 2014, as it is the federative unit with the largest number of companies ([IBGE, 2019](#)), according to [Table 3](#).

Initially, the study clipping included the year 2009; however, 147 municipalities in São Paulo, in that year, did not have any MEI registered, which could distort the data. In 2010, in turn, only five municipalities had a similar situation; and, as of 2011, all municipalities had this register.

Federation Unit	Year				
	2010	2011	2012	2013	2014
São Paulo	1.730.667	1.760.719	1.772.308	1.831.230	1.764.841
Minas Gerais	606.256	607.340	611.521	632.090	601.015
Rio Grande do Sul	491.584	472.343	484.288	498.060	470.737
Paraná	429.071	428.128	444.369	461.538	448.155
Rio de Janeiro	412.022	415.193	418.767	435.181	410.584
Santa Catarina	290.034	287.997	297.744	307.159	309.553
Bahia	264.383	259.889	261.126	273.238	250.906
Goiás	165.946	168.039	172.238	182.129	175.579
Ceará	160.443	157.710	156.616	165.481	147.103
Pernambuco	140.833	142.718	144.509	151.102	139.326
Espírito Santo	105.623	109.048	110.151	114.122	109.579
Distrito Federal	95.388	96.655	99.424	103.345	99.252
Mato Grosso	86.476	84.673	89.773	96.448	92.489
Pará	76.081	76.909	80.278	86.052	77.520
Maranhão	70.171	70.627	72.304	76.812	65.813
Mato Grosso do Sul	64.478	65.308	67.919	71.487	68.971
Paraíba	62.585	62.728	62.247	64.844	60.701
Rio Grande do Norte	59.131	59.294	60.777	62.841	57.746
Piauí	46.640	47.861	48.906	51.673	46.850
Alagoas	39.917	40.048	40.526	42.636	40.729
Amazonas	36.422	36.602	37.550	40.205	33.834
Rondônia	34.374	34.160	35.097	36.670	34.307
Sergipe	31.456	31.652	32.968	33.857	32.073
Tocantins	26.126	26.279	27.431	28.823	27.568
Acre	10.082	10.003	10.032	10.724	9.297
Amapá	8.824	9.257	8.869	9.394	8.578
Roraima	6.902	6.753	6.892	7.324	6.420
Brasil	5.551.915	5.567.933	5.654.630	5.874.465	5.589.526

**Tab. 03**

Number of companies per state of the Federation

**Fonte:** Central Registry of Companies (IBGE, 2020).

For this study, the quantile regression, evidenced by [Hao and Naiman \(1949\)](#), [Santos \(2012\)](#), [Das et al. \(2019\)](#) and [Koenker and Hallock \(2001\)](#), it was considered the most appropriate statistical technique to estimate independent variables, categorized by high variability, due to the high dispersion values of the variables of the Municipal GDP and IFDM research, and the interest in the conditional distribution of the MEI variable, which has several existing and relevant covariates.

Regarding the size of the companies ([Table 4](#)), the results indicate the existence of a greater number of micro-companies.

The objective of regression analysis is to understand the effects of predictor variables on response variables ([Das, Krzywinski, and Altman, 2019](#)), the monetary value of the GDP of São Paulo municipalities and IFDM, and the quantile regression model is considered a natural extension of the linear regression model ([Hao and Naiman, 1949](#)). Compared to the linear regression model which approaches the mean and specifies the change in the conditional mean of the dependent variable associated with a change in the covariates, the quantile regression model specifies the variability that occurs in each conditional quantile ([Hao and Naiman, 1949](#)).

In this type of statistical technique it is possible to perform an equally convenient method to estimate models for conditional quantile functions ([Koenker and Hallock, 2001](#)). Technical analysis in quantiles is a statistical procedure to estimate conditional quantile functions ([Buhai, 2004](#)).

Year	Size (employee number)			
	Micro (< 9)	Small (10 to 49)	Medium (50 to 249)	Large (> 250)
2010	88,5%	9,9%	1,3%	0,3%
2011	88,1%	10,1%	1,4%	0,4%
2012	87,9%	10,3%	1,4 %	0,4%
2013	87,9%	10,3%	1,4%	0,4%
2014	87,9%	10,3%	1,4%	0,4%

**Tab. 04**

Size of companies in Brazil (2010-2014)

**Source:** Elaboration based on data from IBGE (2019).

Quantile regression does not impose any kind of strict parametric assumptions on the analyzed distribution ([Houssou and Zeller, 2011](#)) as well as it is a method for estimating the quantiles of the conditional distribution of a response variable and, as such, allows a much more accurate picture of the relationship



between the response variable and the observed covariates than the methods of Ordinary Minimum Squares (OCM) as described by [Trinks and Scholtens \(2017\)](#). [Das et al. \(2019\)](#) state that quantile regression exploits the effect of one or more predictors in quantiles of the response variable.

For the construction of the model, the methodological steps followed were: (1) definition of GDP and IFDM as dependent variables, based on the studies by [Silva and Porto Júnior \(2006\)](#) and [Caldarelli and Perdigão \(2018\)](#); (2) collection of the population's GDP, IFDM, and MEI values, based on Data Sebrae, IBGE and Datasus; (3) insertion of the data collected in an Excel file, for the creation of the database of the 645 municipalities in São Paulo, in the period from 2010 to 2014; (4) importing the data into the SPSS statistical software; (5) data processing, excluding the municipalities of Altair, Dolcinópolis, Nova Canaã Paulista, Nova Castilho and Populina, due to the absence of MEI, and the municipalities of Cabrália Paulista, Chavantes and Júlio Mesquita, due to the absence of IFDM, totaling eight municipalities not considered, which did not affect, in statistical terms, the final sample of 637 municipalities, due to the size of the excluded municipalities; (6) division of the GDP and MEI variable by the number of inhabitants; (7) normality test of the GDP per capita and IFDM data in the SPSS, according to [Gondim et al. \(2017\)](#), which demonstrated a non-normal behavior of the distribution of the observed variables ([Table 5](#)).

Variable	Kolmogorov-Smirnova			
	Statistics	df	p-value	Test (p-value)
GDP Per capita 2010	0,188	637	0,000	p-value <0,05
GDP Per capita 2011	0,174	637	0,000	p-value <0,05
GDP Per capita 2012	0,183	637	0,000	p-value <0,05
GDP Per capita 2013	0,195	637	0,000	p-value <0,05
GDP Per capita 2014	0,224	637	0,000	p-value <0,05
IFDM 2010	0,034	637	0,085	p-value >0,05
IFDM 2011	0,025	637	0,200*	p-value >0,05
IFDM 2012	0,038	637	0,032	p-value <0,05
IFDM 2013	0,040	637	0,016	p-value <0,05
IFDM 2014	0,044	637	0,005	p-value <0,05

**Tab. 05**  
Result of the GDP Per Capita and IFDM normality test  
**Source:** Research Data.

Next, the following steps were: (8) descriptive statistics of the data per capita GDP of the São Paulo municipalities, showing the standard deviation and variance; (9) definition of model variables, based on studies by [Silva and Porto Júnior \(2006\)](#) and [Caldarelli and Perdigão \(2018\)](#). The structure of the equations followed the basic model of quantile regression for "i" units and "t" periods, by [Hao and Naiman \(1949\)](#), expressed as follows (where  $0 < p < 1$  indicates the proportion of the population with scores below the "p" quantile).

$$y_{it} = \beta_0(p) + \beta_1(p) x_{it} + \varepsilon_{it}(p)$$

In this sense, the model equations were expressed as follows (GDP\_per capitait = GDP value of municipality "i" in time relative to the population in time "t"; IFDMit = IFDM of municipality "i" in time "t"; and MEI\_per capitait = MEI number of municipality "i" at time "t"):

$$\text{GDP\_per capitait} = \beta_0(p) \text{MEI\_per capitait} + \beta_1(p) \text{MEI\_per capitait}$$

$$\text{IFDMit} = \beta_0(p) \text{MEI\_per capitait} + \beta_1(p) \text{MEI\_per capitait}$$

The following steps were: (10) insertion of the treated data, using the statistical software STATA 14.0; (11) data analysis using the multivariate quantile regression technique, referring to quantiles q10, q25, q50, q75 and q90; (12) interpretation of the results of the regressions generated and application of the respective tests of significance.

After carrying out the analyzes, the results obtained are described in the following section.

## RESULTS AND DISCUSSION

The main empirical results of this study, referring to the ten hypotheses tested with data from São Paulo municipalities, analyzed in the period from 2010 to 2014, are detailed below (the database on the quantiles of the socioeconomic indicators used is presented in [Table 6](#) and [7](#)).

The following hypotheses were rejected: H1 (quantile 10), H2 (quantile 25), H4 (quantile 75) and H5 (quantile 90), in the per capita relationship between MEI and GDP; and H6 (quantile 10), H8 (quantile 50), H9 (quantile 75) and H10 (quantile 90), in the relationship between MEI and IFDM.

The result of the Hypothesis test (H3) showed that Individual Microentrepreneurs (MEI) influenced the GDP indicator of São Paulo municipalities, in quantile 50, ceteris paribus. The coefficient, estimated positive and significant, at 1% of the variable related to the MEI, indicated influence on the GDP per capita of the São Paulo municipalities in the 50th quantile, in 2014.

The result of the Hypothesis test (H7) showed that Individual Microentrepreneurs (MEI) influenced the IFDM indicator of São Paulo municipalities, in quantile 25, ceteris paribus. The coefficient, estimated positive and significant, at 1% of the variable related to the MEI, indicated influence in the IFDM of the São Paulo municipalities in the 25th quantile, in 2014.

In general, although the results showed significant coefficients, at the level of 5% and 10%, the empirical evidence did not show significant influences (1%) of the Individual Microentrepreneurs (MEI) in the GDP per capita and in the IFDM of the selected municipalities, in the quantiles q.10, q.75 and q.90, in none of the analyzed periods.

It is worth remembering that quantiles are cut-off points on the scale of the GDP per capita variable. Thus, it is observed ([Table 6](#)) that, in quantile 10, the data of the municipalities with maximum values of R \$ 8,917.00 are included, described in the GDP per capita, in the period of 2010; and, in quantile 90, in the same year, municipalities that have a minimum value of R\$ 33,670.00 of GDP per capita are included.

Year	Quantiles				
	q.10	q.25	q.50	q.75	q.90
2010	8,917	11,117	15,531	22,218	33,670
2011	9,676	11,916	17,116	24,825	36,827
2012	10,449	13,514	18,110	27,170	40,611
2013	11,251	14,413	19,401	28,303	43,128
2014	12,273	15,818	21,463	30,995	46,062

**Tab. 06**  
Per Capita GDP Quantiles in R\$ thousands (Brazilian Reais)  
**Source:** Research Data

As for the São Paulo municipalities with high development, that is, with IFDM between 0.8 to 1.0 development (the closer the indicator is to 1, the greater the development of the locality), they fall into quantiles 0.75 and 0.90 (Table 7).

The evolution analysis of these variables showed that the component data of the base used by this study showed a heterogeneity in the GDP per capita of the São Paulo municipalities, which is evidenced by the high value of the standard deviation and the variation coefficient, indicating the spread of these data by a range of values (Table 8). This evidence reinforced the use of the quantile regression technique.

Year	Quantis				
	q.10	q.25	q.50	q.75	q.90
2010	0,675	0,716	0,764	0,815	0,862
2011	0,681	0,725	0,772	0,818	0,859
2012	0,695	0,735	0,781	0,831	0,866
2013	0,696	0,737	0,786	0,828	0,864
2014	0,691	0,728	0,771	0,818	0,852

**Tab. 07**

IFDM Quantiles

Source: Research Data.

It can be seen, from the data presented previously (Table 8), that there was an increase in the average of GDP per capita in the period, in relation to the average of the previous year. For Sweeney et al. (2013), the variation coefficient indicates what the sample standard deviation represents, as a percentage of the average value. It is inferred, therefore, that the coefficients of variation from 2010 to 2014 showed a high dispersion, in relation to the value of the sample average.

Year	R\$ Thousands (Brazilian Reais)			
	Mean	Standard Deviation	Variance	Variation Coefficient (%)
2010	19,456	15,554	241,931	79,94
2011	21,235	15,945	254,243	75,09
2012	23,278	18,291	334,556	78,58
2013	24,924	20,316	412,732	81,51
2014	27,876	26,733	714,665	95,90

**Tab. 08**

Average, standard deviation and variance of GDP Per capita

Source: Research Data.

The figures referring to the average of the IFDM of the São Paulo municipalities, from 2010 to 2014 (Table 9), showed an increasing increase from 2010 to 2013, and a decrease in 2014, in the data set. Regarding the values of the coefficients of variation, in the analyzed period, a low dispersion is observed in relation to the value of the mean of the sample IFDM. It is worth noting, then, that there was a decrease in dispersion over the period. As for the position relationship in the IFDM of the São Paulo municipalities, it is inferred that the average showed the majority categorized in moderate development (from 0.6 to 0.8) to high development (0.8 to 1).

There is an estimated positive and significant coefficient, at levels of 1 to 10%, in the period from 2012 to 2014 (Table 10), indicating the contribution of the MEI to the economic growth of the municipalities. This result corroborates the literature on the topic, which shows the potentialization of the emergence of MEI

Year	Mean	Standard Deviation	Variance	Variation Coefficient (%)
2010	0,766	0,068	0,005	8,88
2011	0,771	0,067	0,004	8,69
2012	0,780	0,064	0,004	8,21
2013	0,782	0,062	0,004	7,93
2014	0,771	0,061	0,004	7,91

**Tab. 09**

Mean, standard deviation and variance of IFDM

Source: Research Data.

in times of unemployment (Gondim et al., 2017), a phenomenon perceived by Barros and Pereira (2008), and a fact that explains entrepreneurship by necessity, according to Amorós et al. (2019).

GDP		Quantiles				
		q10	q25	q50	q75	q90
2010	$\beta$	-1.2 e <sup>+05</sup>	-9.6 e <sup>+04</sup>	5.4 e <sup>+04</sup>	-3.7 e <sup>+05</sup>	-7.0 e <sup>+05</sup>
	p-value	0.2124	0.3507	0.7418	0.2669	0.3461
2011	$\beta$	-1.6 e <sup>+04</sup>	-4.3 e <sup>+04</sup>	-8.8 e <sup>+04</sup>	-2.1 e <sup>+05</sup>	-6.1 e <sup>+05</sup>
	p-value	0.8186	0.5003	0.4511	0.3515	0.2300
2012	$\beta$	4.1 e <sup>+04</sup>	7.9 e <sup>+04</sup>	1.4 e <sup>+05</sup>	9.9 e <sup>+04</sup>	3.5 e <sup>+05</sup>
	p-value	0.4475	0.1529	0.0700***	0.5827	0.3148
2013	$\beta$	2.8 e <sup>+04</sup>	7.5 e <sup>+04</sup>	1.5 e <sup>+05</sup>	1.6 e <sup>+05</sup>	5.9 e <sup>+05</sup>
	p-value	0.4847	0.1372	0.0280**	0.2481	0.1047
2014	$\beta$	9.6 e <sup>+04</sup>	8.2 e <sup>+04</sup>	1.5 e <sup>+05</sup>	2.9 e <sup>+05</sup>	5.8 e <sup>+05</sup>
	p-value	0.0130**	0.0759***	0.0096*	0.0112**	0.0849***

**Tab. 10**

Relationship of MEI's to the GDP of São Paulo State municipalities

Note: ( $\beta$ ): coefficients; p-value: (\*) significant at the 1% level; (\*\*) significant at the 5% level; (\*\*\*) significant at the 10% level. Source: research data (2019)

Source: Research data (2019).

In this article, it was chosen to highlight the coefficients estimated as significant at the level of 1%, considering that, when making this cut, the measure of development of the MEI had a significant effect in the case of the median (quantile 0.50), that is, municipalities with GDP per capita between R\$ 21,463.00 and R \$ 30,995.00, in 2014.

Regarding the analysis of the MEI variable as a proportion of the IFDM growth from 2010 to 2014, the majority was found to be a coefficient estimated as positive for socioeconomic growth (Table 11). However, when investigating the estimated coefficients on IFDM growth, only the quantiles q.50, in 2013, and q.10, q.25 and q.50 were statistically significant, at the levels of 1%, 5% and 10%, respectively. In these measures of economic growth, the estimated coefficient of the independent variable affected municipalities with IFDM up to 0.691, in 2013, and up to 0.771, in the 2014 period. ), q.25 shows the best result.

From the results (Table 6), it appears that the effect of the creation of the MEI presented a more significant estimated coefficient in municipalities with low to medium socioeconomic growth.





IFDM		Quantiles				
		q10	q25	q50	q75	q90
2010	$\beta$	0.8359	-0.0905	1.4005	1.0996	-1.7502
	p-value	0.6014	0.9546	0.3299	0.5301	0.2834
2011	$\beta$	0.4369	0.2382	0.0993	0.0594	-0.9249
	p-value	0.6965	0.8050	0.9052	0.9531	0.2878
2012	$\beta$	1.2405	0.5979	0.8956	0.2852	-0.4522
	p-value	0.1454	0.3971	0.1126	0.6783	0.3802
2013	$\beta$	0.5421	0.8542	1.0141	0.3712	-0.1088
	p-value	0.3623	0.1117	0.0411**	0.4653	0.8260
2014	$\beta$	0.9405	1.2385	0.8472	0.2714	0.7379
	p-value	0.0857***	0.0026*	0.0472**	0.5045	0.1085

**Tab. 11**

MEI's in IFDM relation in São Paulo State municipalities

Note: ( $\beta$ ): coefficients; p-value: (\*) significant at the 1% level; (\*\*) significant at the 5% level; (\*\*\*) significant at the 10% level.

Source: Research Data.

Extracting the municipalities from the quantiles described with the best percentage of significance (1%) (Table 10 and 11), there is a total of 159 municipalities in São Paulo in the q.50 of GDP (Table 10); and 96 in IFDM q.25 (Table 11). When crossing between the municipalities of the two indicated quantiles, a total of 24 municipalities were obtained (both described in Table 12).

It was evidenced (Table 12), then, the municipalities that presented a positive and significant estimated coefficient of the MEI in relation to the GDP per capita and the IFDM, together, in 2014. It is observed, therefore, that almost all the municipalities of this category have a population of less than 30,000 inhabitants, with the exception of Piedade, which has over 54,000 inhabitants and the largest number of MEI registered. Another evidence was that 16, of the 24 municipalities, have less than 10,000 inhabitants.

The highest GDP per capita pointed out was that of the municipality of Iacri, with a value of R\$ 21,230.71; and the largest IFDM is from the municipality of Conchas, even so, within the q.25 range, of the IFDM quantiles, described in Table 5.

Eight municipalities have a total of less than 100 MEI registered and, with a median of 142.5 MEI per municipality, it can be inferred that the contribution to economic development was significant for municipalities with small characteristics and low socioeconomic development.

## FINAL CONSIDERATIONS

This study endeavored to contribute to the understanding of the socioeconomic relationship of the MEI, in the period from 2010 to 2014, in the São Paulo municipalities, in the different quantiles, of the socioeconomic indicators PIB Municipal and IFDM, and the results confirmed the findings of the literature on the theme, demonstrating that such relationships are significant.

The main subsidies of this work are: (1) characterization of the relations by strata of low, medium and high GDP and IFDM; (2) partial expansion of the understanding of previous studies on the different relations of the MEI on the quantiles of GDP and IFDM of the cities in São Paulo, which were the object of this research; and (3) clarification of the reader's understanding, by pointing out that the MEI relationship is limited to the different categories of municipal socioeconomic development, but that cannot yet indicate a comprehensive view of the phenomenon.

#	Municipalities	GDP (R\$ thousands)	Population	MEI	IFDM	MEI per capita
1	Águas da Prata	131.446,30	7.984	143	0,701	0,0179
2	Anhembi	109.800,26	6.215	168	0,725	0,0270
3	Arco-Íris	34.627,23	1.907	31	0,719	0,0163
4	Cajuru	493.496,12	25.009	597	0,709	0,0239
5	Cesário Lange	312.418,02	16.943	304	0,718	0,0179
6	Conchas	291.432,66	17.286	247	0,726	0,0143
7	Flora Rica	31.397,19	1.666	28	0,703	0,0168
8	Floreal	63.872,03	3.027	73	0,707	0,0241
9	Guará	434.719,74	20.823	678	0,717	0,0326
10	Guarantã	122.801,41	6.640	127	0,722	0,0191
11	Iacri	138.105,74	6.505	74	0,712	0,0114
12	Miracatu	372.491,13	20.660	576	0,702	0,0279
13	Mirandópolis	608.442,00	28.902	574	0,723	0,0199
14	Monte Castelo	71.858,26	4.187	51	0,719	0,0122
15	Paulo de Faria	176.506,55	8.909	178	0,716	0,0200
16	Pedranópolis	44.880,68	2.582	37	0,717	0,0143
17	Piedade	1.109.388,45	54.523	904	0,718	0,0166
18	Pongai	64.072,79	3.523	55	0,705	0,0156
19	Presidente Alves	69.931,43	4.192	103	0,716	0,0246
20	Sales	105.479,85	5.929	142	0,693	0,0240
21	Santa Branca	241.117,95	14.465	262	0,698	0,0181
22	Santa Cruz da Esperança	36.521,72	2.070	48	0,711	0,0232
23	Taciba	109.130,47	6.067	133	0,720	0,0219
24	Tapiraí	144.437,13	8.085	227	0,720	0,0281
Average		221.598,96	11587,46	240	0,713	0,0203
Median		127.123,86	6.572,50	142,5	0,716	0,0199

**Tab. 12**

Municipalities with significant MEI relation to GDP and IFDM in 2014

Source: Research Data.

The GDP per capita and IFDM data were categorized into quantiles of 10, 25, 50, 75 and 90, with significant relationships being observed in only two of them. Two confirmed hypotheses were limited to the significantly positive relationship of the MEI in municipalities with low and medium economic growth. As such, Individual Microentrepreneurs (MEI) were determinants for GDP per capita in quantiles 50 and 25 of the IFDM, in 2014, for 24 municipalities, after comparing the total number of municipalities for each quantile extracted. The results call attention to the fact of the greatness of the group of municipalities: almost all, with less than 30,000 inhabitants, except one, with 54,000 inhabitants. And, taken together, they all focus on the low-growth range of IFDM. The quantitative results suggest that the larger municipalities, or even those with higher IFDM, in this study, did not demonstrate an evolution in the economic development provided by the total registered MEI, although, in general, the total MEI has grown with greater intensity than GDP.

It is also necessary to consider, as possible influences to the statistics, the changes in the behavior of the current labor market, and the relationship between employment and



entrepreneurship, with the new forms of employment contract, which involve legal entities instead of the direct contract. with individuals. In addition, there is a tendency for job insecurity, with new contracts between legal entities, replacing traditional labor contracts with individuals, which is a recommendation for specific future studies. The absence of standardized data and the challenges in consulting databases, even public ones, to obtain data related to small businesses and entrepreneurship, make the study difficult. To this end, the monitoring of new clippings, based on the availability of more up-to-date data, contributes to the counterpointing effect, in a more recent scenario. Taking into account other determinant aspects, foreseen in public policies, can be a starting point to complement the deepening on the theme.

As the state of São Paulo is the country's economic thermometer, comparative studies in other states can be interesting to highlight different sizes and entrepreneurial realities.

It is also important that studies on individual microentrepreneurs are carried out, given the low volume of academic publications on the segment, especially quantitative research that allows us to observe statistically the real contribution to economic and social development.

Specifically for the 24 municipalities, identified in 2014 by the characteristics observed, all with low population, the majority with less than 10,000 inhabitants (16 of the 24 municipalities), average GDP and low IFDM, in addition to the quantitative aspect, marked by the estimated coefficient, with statistical significance in the study on the total registered MEI, other factors that eventually stimulate the situation, such as the literature deals with public policies, always taking into account more than one variable, can be performed.

Still, when doing a geographic mapping with the 24 municipalities, in an empirical way, it was observed a relative proximity, in small clusters between them, and this aspect may or may not be an explanatory factor, which deserves a specific research about it.

For greater depth and understanding of the quantitative results, it is suggested to carry out qualitative studies, under different approaches, to observe any local influences for the phenomenon, as well as other stimuli, local or regional.

#### Authors' statement of individual contributions

Roles	Authors Contributions		
	Benatti, LN	Silva, EE	Prearo, LC
Conceptualization	X	-	-
Methodology	-	-	X
Software	-	X	-
Validation	X	X	-
Formal analysis	X	X	-
Investigation	X	-	-
Resources	-	-	X
Data Curation	X	X	-
Writing - Original Draft	X	X	-
Writing - Review & Editing	X	X	-
Visualization	X	X	-
Supervision	-	-	X
Project administration	X	-	-
Funding acquisition	-	-	X

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#### Conflict of interest statement

The authors hereby confirm that there are no competing interests to declare.

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