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## Quality of Life in Portuguese Municipalities: A Multidimensional Approach<sup>1</sup>

**Abstract.** The estimation of the level of development of a territory is an issue that has had different approaches and methodologies. If the first attempts were associated with determining the income generated and retained by the territory, the most recent indicators of quality of life or well-being are based on a multidimensional concept, improved by adding other dimensions including several variables. On the other hand, despite the statistical difficulties, analysis of smaller geographic units is closer to reality, allowing researchers to draw relevant and effective final considerations. Focusing on the case of Portugal mainland, an old country with strong and persistent development asymmetries, this work sought to examine the similarities and differences in various dimensions of the concept of quality of life, in the positioning of the chosen territorial units, the municipalities. Then, after collecting recent annual variables at the municipality level, data were processed using multivariate analysis. The construction of clusters revealed affinities between the municipalities. The results obtained show the asymmetries of development and well-being in the national territory, and their disaggregation, both in terms of the multiple dimensions under analysis and in terms of the municipalities. The study offers a greater and deeper understanding of the regional reality and consequently can favour the efficiency of cohesion policies.

**Keywords:** quality of life, well-being, territorial asymmetry, regional development, multivariate approach, cluster analysis

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## ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

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## Качество жизни в муниципалитетах Португалии: комплексный подход

**Аннотация.** Существует множество подходов и методологий оценки уровня развития территорий. Первоначально для его определения использовались только экономические показатели, такие как доходы, полученные на данной территории. В настоящее время для исследования качества жизни или благополучия населения применяется комплексный подход, включающий несколько переменных. Несмотря на трудности с получением статистической информации, именно анализ более мелких географических единиц позволяет увидеть реальную картину развития территории, а также сделать соответствующие выводы. Объектом настоящего исследования стала континентальная Португалия – государство, характеризующееся существенной асимметрией развития. Анализ различных показателей качества жизни продемонстрировал сходства и различия в развитии выбранных территориальных единиц – муниципалитетов. Для оценки данных за год на уровне муниципалитетов был применен метод многомерного анализа. Выявленные кластеры отражают сходство между муниципалитетами. Полученные результаты свидетельствуют о неравномерном развитии страны, определяющем качество жизни населения, а также демонстрируют различия кластеров как по многочисленным анализируемым показателям, так и по муниципалитетам. Поскольку исследование предлагает более глубокое понимание регионального развития, содержащиеся в работе выводы могут быть использованы для совершенствования политики сплочения.

**Ключевые слова:** качество жизни, благосостояние, территориальная асимметрия, региональное развитие, комплексный подход, кластерный анализ

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### 1. Introduction

Nowadays, the development of a territory is no longer measured from a purely economic perspective, but by resorting to broader and multidimensional concepts such as quality of life and well-being. This approach has been used by various official institutions including the United Nations (UN), World Bank, Organisation for Economic and Social Cooperation (OECD) and European Union (EU) through their statistical and reporting sections and several published studies. These organisations support the need to know and compare the reality of the countries and the disparities and development gaps between them, in order to advise policy makers that can promote better actions for answer to the major challenges of our time, main of which are part of the Sustainable Development Goals set in 2016 by the UN, under the 2030 Agenda (UNIRC, 2018)<sup>1</sup>.

Portugal is a small country in Western Europe that has belonged to the European Union since

1986 and whose inter-regional asymmetries are quite pronounced. However, at present, despite higher levels of development and quality of life across the country (compared, for example, to the 1980s of the 20th century), development differences between regions have increased. This makes it an interesting case study, as the country has benefited largely from support for cohesion and the reduction of structural differences with funding from the European Union. In the context of the OECD, the European Union and internally in Portugal – either by the Statistics Portugal (INE) or by various researchers – the problem of asymmetries in territorial development and differences in quality of life has been diagnosed and evaluated. Existing studies, especially those of an institutional nature, predominantly study the NUTS (Nomenclature of Territorial Units for Statistics) II and NUTS III regions and use indicators created specifically for this purpose that, in many cases, are not possible to replicate in other contexts. In this study, the municipalities of mainland Portugal are the object of analysis and we use statistical data available to all researchers. This work aims to develop a tool linked to the issue of qual-

<sup>1</sup> UNIRC – Centro de Informação Regional das Nações Unidas para a Europa Ocidental (2018). Agenda 2030 para o desenvolvimento sustentável. Retrieved from: [www.unirc.org/pt](http://www.unirc.org/pt). (Date of access: 21.07.2021).

ity of life that can be applied to as small as possible territorial units, within the limits of the capacity to act, that is, territorial units with political and budgetary autonomy, and for which statistical data are available. In fact, it will be empirically applied to 278 municipalities of the Portuguese mainland.

The study of inequalities is relevant because it not only broadens the economic perspective, but also seeks to enrich the analysis with the other dimensions of the concept of sustainable development, the environmental and social ones. These dimensions will be broken down into several areas, as referred to in the next section.

The work that follows this introduction is structured in five sections: a brief conceptual framework of the problem under study; a succinct presentation of the Portuguese territorial asymmetries; the presentation of the objectives, data and methodology; the results obtained and their discussion; the final considerations.

## 2. Conceptual Framework

“What you measure affects what you do”  
(Stiglitz et. al, 2018, p. 7)

The topic of territorial inequalities, whether theoretically, from the conceptual and methodological points of view, or in practice, has been an object of growing interest of politicians, academics and other social agents. New forms of governance, with an increasingly strong participation of civil society, the progressive demand for greater transparency in public policies and a growing awareness of the common good have contributed to this interest. It is a common understanding that these inequalities are not only questionable or undesirable considering basic principles of equity, but in a less subjective perspective, there is a perception that these inequalities can compromise global development.

As already mentioned, if in the first phase the measurement of inequalities was limited to purely economic criteria, in recent decades it became clear that it is necessary to extend this concept to other dimensions, and it is in this context that the term quality of life appears.

This concept of quality of life was associated with economic growth after World War II. Despite experiencing a real development in the 1970s (Landeiro et. al, 2011), it was only at the end of the century that the problematic was truly internalised. Therefore, from the 2000s onwards, reports on quality of life by European organisations began to be regularly published, such as the European Quality of Life Surveys (EQLS), the first of which was published in 2003 by the European

Foundation for the Improvement of Living and Working Conditions.

Regarding these reports, we can read in the last published, relative to year 2016, that “this unique, pan-European survey examines both the objective circumstances of citizens’ lives as well as how they feel about those circumstances and their lives in general, with an aim to create a rich data source on the quality of life of the people in Europe. The survey presents data on issues that general statistics of not cover, such as the perceived quality of society, trust in institutions and social tensions”<sup>1</sup>. Accordingly, “the report provides an overview of multiple dimensions: it examines subjective well-being, optimism, health, standard of living and aspects of deprivation, work–life balance; healthcare, long-term care, childcare and other public services; social insecurity, perceptions of social exclusion and societal tensions, trust in people and institutions, participation and community engagement, and involvement in training or lifelong learning”<sup>2</sup>.

After the “Report of the Commission on the Measurement of Economic Performance and Social Progress” (Stiglitz et. al, 2009), which recommended national statistical agencies to collect and publish measures of subjective well-being, the OECD presented its «Guidelines on Measuring Subjective Well-being”. The text referred to its pioneering role, stating “the objective to measure society’s progress across eleven domains of well-being, ranging from jobs, health and housing, through to civic engagement and the environment”<sup>3</sup>.

This growing complexity towards a greater scope of concepts is clearly evident in the OECD Social and Welfare Statistics, which currently provide two instruments: the database «How’s Life? Well-being”<sup>4</sup> and the “Better Life Index”<sup>5</sup>. The da-

<sup>1</sup> Eurofound. (2017). European Quality of Life Surveys (EQLS) 2016. Retrieved from: [https://www.eurofound.europa.eu/sites/default/files/ef\\_publication/field\\_ef\\_document/ef1733en.pdf](https://www.eurofound.europa.eu/sites/default/files/ef_publication/field_ef_document/ef1733en.pdf). (Date of access: 22.07.2021).

<sup>2</sup> Eurofound. (2017). European Quality of Life Surveys (EQLS) 2016. Retrieved from: [https://www.eurofound.europa.eu/sites/default/files/ef\\_publication/field\\_ef\\_document/ef1733eang=en](https://www.eurofound.europa.eu/sites/default/files/ef_publication/field_ef_document/ef1733eang=en). (Date of access: 11.08.2021).

<sup>3</sup> OECD. (2013). OECD Guidelines on Measuring Subjective Well-being. OECD Publishing. Retrieved from: <https://www.oecd.org/wise/oecd-guidelines-on-measuring-subjective-well-being-9789264191655-en.htm>. (Date of access: 12.07.2021).

<sup>4</sup> OECD. (2021). How’s Life? Well-Being. OECD Social and Welfare Statistics (database). Retrieved from: <https://www.oecd.org/wise/how-s-life-23089679.htm> (Date of access: 22.07.2021).

<sup>5</sup> OECD. (2021). Better Life Index. OECD Social and Welfare Statistics (database). Retrieved from: <https://www.oecdbetter->

tabase «How's Life? Well-being» has more than 80 indicators of the OECD Well-being Dashboard, providing information on well-being outcomes, inequalities and the resources and risks that support future well-being, distributed over 11 dimensions. These dimensions of current well-being are related to people's material and economic conditions (income and wealth, housing, work and quality of employment) and quality of life factors that encompass how well people are and how well they feel, what they know, can do and how healthy and safe their homes and places are (health, knowledge and skills, environmental quality, subjective well-being, safety). The concept also covers how connected and engaged people are, and how and with whom they spend their time (work-life balance, social connections, civic engagement).

Additionally, the "Better Life Index" allows researchers to compare well-being across countries as well as to measure well-being based on the 11 topics or dimensions referred above and identified as essential by the OECD.

In this context and regarding the country under study, Portugal, Statistics Portugal produces an "Index of Well-being" (IBE) and a "Synthetic Index of Regional Development" (ISDR), as well as "Sustainable Development Indicators" (SDI)<sup>1</sup>.

The IBE is an indicator that seeks to fill the gap in information regarding the assessment of quality of life and satisfaction of families, particularly in certain more vulnerable population subgroups and for which the definition of efficient policies requires more focused statistics capable of capturing objective, but also subjective dimensions of well-being, in line with the multi-annual programmes of the European Statistical System. It is an indicator calculated at the national level<sup>2</sup>. On a smaller territorial scale (NUTS III), INE presents the ISDR, which collects variables to cover 3 areas: Competitiveness, Cohesion and Environmental Quality. In turn, SDI are a tool for monitoring the National Strategy for Sustainable Development based on 80 indicators that are intended to evaluate the progress of Portugal concerning sustainable development in terms of the objectives and targets set in the strategy. In this case, the indicators' framework is a contract signed between

Statistics Portugal and Eurostat to develop a set of indicators to monitor the National Strategy for Sustainable Development. The data are available for a national level.

With an increasing interaction with the institutional component, research work on this theme has grown, varying in the conceptual dimensions considered, in the methodologies, territories and scales used. In fact, several researchers tried to build indices as new variables in order to test the possibility of capturing other aspects possibly inherent to well-being and quality of life, especially in the more subjective field; the case of Carrasco-Campos et. al (2017) is an example. Statistical and econometric methodologies are also various, with a particular focus on multivariable statistics.

The use of multivariable statistics is present in a large majority of studies, such as the one done by Maricic (2019), assessing the quality of life in the European Union through the composite index ranking of the European Union (EU) Member States, and using a multivariable statistical analysis, the Principal Component Analysis (PCA) and the Scatter Search Composite I-Indicator (eSS-CIDI) enhanced hybrid approach.

Many other authors also resorted to multivariable statistics, such as Rego et. al (2021) who studied the strongly asymmetrical distribution of the population, quality of life and economic development in Portugal. In this case, the multivariate approach was used in order to fulfil the objectives of trying a classification of territorial units according to their respective levels of development and distinguishing them through the most relevant variables. Also Goletsis and Chletsos (2011), focused on the measurement of development and regional disparities in Greek periphery, used multivariate statistical approaches, and so did Soares et. al (2003).

And finally, there is also a multiplicity of territorial scales, from a set of countries, or individual countries to various types of regions.

Particularly, in terms of the variety of territories on an international scale, the following recent works can be referred to: Ehrlich et. al (2021) assessed the economic well-being in U.S. metropolitan areas; Shi et. al (2021) examined the quality of life in Chinese cities; Dardha and Rogge (2020) focused on measuring the regional material living conditions, quality of life and subjective well-being in OECD countries; Saha et. al (2020) tried to identify, through a case study, the factors influencing perceived quality of life of Indian Elderly.

Silva Ferentz et. al (2020) proposed a sustainable development indicator based on quality of

lifeindex.org/pt/#/1111111111 (Date of access: 22.07.2021).

<sup>1</sup> INE. (2021). Retrieved from: [https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine\\_idsustentavel&contexto=&selTab=tab0&INST=141207374&xlang=en](https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_idsustentavel&contexto=&selTab=tab0&INST=141207374&xlang=en) (Date of access: 11.08.2021).

<sup>2</sup> INE. (2013). Índice de Bem-Estar. Versão 1.0. Documento Metodológico. Retrieved from: <https://smi.ine.pt/DocumentacaoMetodologica/Detalhes/?id=1226&lang=PT> (Date of access: 23.07.2021).

Table 1

Summary table: Portugal in Europe

Indicators	Portugal	EU 27
Resident population, 2019	10,286,263	447,265,387
Population density, 2016	112.1	105.3
At risk of poverty rate (%), after social transfers, 2018	17.3	16.8
Early school leavers rate (%), 2019	10.6	10.2
Unemployment rate (%), 2019	6.5	6.7
Gross domestic product (GDP) per capita (PPS), 2019	24,388	31,142
Private consumption as a % of GDP, 2019	64.1	53.1

Source: FFMS, 2020 (FFMS — Francisco Manuel dos Santos Foundation. (2020). Portrait of Portugal in Europe PORDATA, 2020 Edition. Retrieved from: <https://www.pordata.pt/en/Portraits/2020/Portrait+of+Portugal+in+Europe-87>. (Date of access: 23.07.2021)).

life, well-being and happiness in a Brazilian city. Shams and Kadow (2019) examined the relationship between subjective well-being and work-life balance among labourers in Pakistan. Calcagnini and Perugini (2019) presented a study on well-being in the Italian provinces, done at the regional level (NUTS III).

As for works done on Portuguese territory and in addition to the aforementioned work by Rego et. al (2021), the following works should be mentioned: Dionísio and Rego (2020), Amado et. al (2019), Özgür and Aylin (2011), Pinto and Guerreiro (2010), Diniz and Sequeira (2008), as well as the study by Fonseca<sup>1</sup>.

Dionísio and Rego (2020), based on a fuzzy sets approach, provided a comparison of the quality of life in urban, intermediate and rural Portuguese regions (NUTS III). The study by Amado et. al (2019) compared the quality of life of cities that lost population with that of cities that gained population by employing a non-parametric approach.

Pinto and Guerreiro (2010) and Diniz and Sequeira (2008) both presented the analysis of Portuguese regions using cluster analysis. The former focused on the understanding of the Algarve regional innovation systems, a peripheral Portuguese region in the National and European framework, and the latter estimated the Social and Economic Development Index (SEDI), regarding each municipality of Portugal (called at the time NUTS IV).

Finally, in his pioneering work, Fonseca presented the objective of quantifying the level of economic and social development of regions and municipalities of mainland Portugal. To this end, he resorted to partial development indices, supported by applications of factor analysis of main components. Additionally, he calculated an overall development index.

These last two works, despite having been carried out at the municipality level, included mainly economic and social variables (related to employment and demography), without reaching the multidimensionality currently considered and required in most studies related to the concept of well-being and quality of life.

### 3. Portuguese Context

Portugal is a small country (about 560 km from north to south and just over 200 km from the coast to the border with Spain) located in the western periphery of the European Union, one of the poor-

est countries that integrated a rich set of nations, and with stronger internal asymmetries. Table 1 shows a set of generic indicators, which present a review of the country in comparison with the European Union, to which Portugal is part since 1986, as mentioned above.

According to Table 1, Portugal represents about 2.3 % of the EU population, with a population density higher than the European average. However, this population, despite having an unemployment rate slightly lower than the average, is characterised by a higher risk of poverty, early school leaving and higher private consumption in GDP. In addition, the country has a very low GDP per capita, far below the European Union average. These data describe a country with an overall income level significantly lower than the average of partner countries in the European Union and with structural characteristics associated with high levels of poverty and, consequently, with higher levels of school dropouts.

In addition to the significant differences in Portugal's development and well-being, compared to its European partners, one of the country's main problems is development differences between various regions. For example, if we analyse the distribution of the little wealth within the country relative to the EU, we find deep asymmetries, specifically in terms of purchasing power per capita across the country<sup>2</sup>.

<sup>1</sup> Fonseca, P. (2002). Índices de desenvolvimento concelhio. Revista de Estatística. INE. 2º Quadrimestre de 2002.

<sup>2</sup> FFMS — Francisco Manuel dos Santos Foundation. (2016). Portrait of Municipalities PORDATA, 2016 Edition. Retrieved from: <https://www.pordata.pt/en/Portraits/2016/Portrait+of+Municipalities-41>. (Date of access: 22.07.2021).

The consequence of the inter-regional imbalances existing in Portugal became clearly visible in the provisional population census data (CENSUS, 2021, by Statistics Portugal), released recently<sup>1</sup>. According to the results published by INE, between 2011 and 2021, Portugal lost about 2 % of the population. However, this evolution was very different across the country: some municipalities, especially the metropolitan areas of Lisbon and Porto and Algarve, saw the significant population increase, while most inland municipalities witnessed a loss of population (in some cases population loss reached 20 %).

This distinct evolution of the resident population throughout the country reflects the differences in the occupation of the territory, in the age structure of the population and in economic activity. Most of the country faces what is called the «Vicious Cycle of Low Density» (Rego & Baltazar, 2011) which associates the loss of population and economic activity with weaknesses in support activities and in public services that ensure an adequate quality of life.

This scenario has been receiving the attention of the Portuguese government, which, in the last decade, defined a Programme for the Enhancement of the Interior<sup>2</sup>, following the previous creation of the National Programme for Territorial Cohesion<sup>3</sup>. These documents define a set of objectives and public policy strategies with a view to minimising inter-regional asymmetries in Portugal.

#### 4. Objectives, Data and Methods

The main objective of this work is to comparatively analyse the Portuguese regions at the level of the variables usually used in the multidimensional analysis of quality of life, bringing as main innovation the use of a smaller territorial scale, the scale of the municipality. This decrease in the territorial scale – the previous works, until now, use larger scales, aggregating more extensive areas of territory – brings as great difficulty the reduction of the available statistical data, but as a great advantage the

possibility of allowing a better knowledge of the territory and, therefore, enhancing a greater effectiveness of development support policies. Therefore, the knowledge, in terms of identity, about what groups and what distinguishes the Portuguese municipalities in terms of variables related to their quality of life, is the main focus of this work.

The hypotheses of this research work are as follows:

*H1:* The Portuguese municipalities remain at different levels in terms of the quality of life dimensions, being expected to have, at least, a «Portugal at two or three speeds»;

*H2:* The inland municipalities of Portugal differ from the coastal municipalities in the various dimensions of quality of life;

*H3:* Population location and productive activity are important variables to distinguish groups of municipalities with regard to the quality of life dimensions;

*H4:* The current public policies (governance) are not significant to reduce the asymmetries among the different levels of quality of life of the groups of municipalities.

This research work is based on a multivariate approach in order to achieve the determined objectives. The data were selected according to the literature review and is described in a more detailed way in the next subsection.

##### a. The Data

The selection of the variables/indicators (dimensions) was based on the European Quality of Life framework<sup>4</sup> and inspired by the literature review about QoL discussed before, having in consideration the hypotheses under analysis. In general, the data used in this study are related to the years 2018 and 2019. The variables and respective indicators (Tables 2 and 3) were chosen for municipalities among those available in Portuguese statistics, with the objective of correctly assessing the following eight dimensions: (i) living conditions and population; (ii) productive activity; (iii) health; (iv) education; (v) physical security; (vi) leisure and social interactions; (vii) governance; and (viii) environment. According to Eurostat, these dimensions represent the different complementary aspects of quality of life and concern the functional capabilities that citizens should have available to effectively pursue their self-defined well-being, according to their own values and priorities.

<sup>1</sup> INE. (2021). Retrieved from: [https://www.ine.pt/scripts/db\\_censos\\_2021.html](https://www.ine.pt/scripts/db_censos_2021.html). (Date of access: 11.08.2021).

<sup>2</sup> Portugal-Gov. (2021). Retrieved from: <https://www.portugal.gov.pt/pt/gc22/governo/programas-de-acao-governativa/programa-de-valorizacao-do-interior/valorizacao-do-interior/visao-do-programa-de-valorizacao-do-interior-pdf.aspx>. (Date of access: 11.08.2021).

<sup>3</sup> Portugal-Gov. (2016). Retrieved from: <https://www.portugal.gov.pt/pt/gc21/governo/programa/programa-nacional-para-a-coesao-territorial/ficheiros-coesao-territorial/programa-nacional-para-a-coesao-territorial-pdf.aspx>. (Date of access: 11.08.2021).

<sup>4</sup> EUROSTAT. (2021). Retrieved from: <https://ec.europa.eu/eurostat/web/quality-of-life>. (Date of access: 11.08.2021).

Description of all collected and treated variables

Variables	Description
Pcpercapita	Purchasing power per capita
Ganho_mensal_trab	Average monthly earnings of employees, total
Rec_impuestos	City municipal tax revenue per capita
Benfef_RSI	Beneficiaries of Minimum Guaranteed Income and Social Security Insertion Income in the total
BenfSDes	Beneficiaries of Social Security unemployment benefit in total active beneficiaries (%)
Depositos	Customer deposits at banks, savings banks and mutual agricultural credit banks, total
Credito	Credit granted to customers by banks, savings banks and mutual agricultural credit institutions, total
Ind_aloj	Average number of individuals per classic family accommodation
Desempregados	Unemployed registered in employment and vocational training centres in the total resident population aged 15 to 64 years (%)
Trab_outrem_Total	Employees, total
Trab_outrem_sup	Employees with higher education in total, %
Trab_outrem_parcial	Employees, part-time
Oferta_emprego	Job offers (annual average) available at employment and vocational training centres, total
Sal_min_rem_media	Difference between national minimum wage and average monthly base salary
Sobrv_empresas_total	1-year survival rate of non-financial companies: by sector of economic activity (total)
Sobrv_empresas_agricpescas	1-year survival rate of non-financial companies: by sector of economic activity (agriculture and fisheries)
Sobrv_empresas_industria	1-year survival rate of non-financial companies: by sector of economic activity (Industry)
Sobrv_empresas_Serviços	1-year survival rate of non-financial companies: by sector of economic activity (services)
Produtividade	Apparent labour productivity of non-financial firms
Alojamento	Accommodation capacity per thousand residents
Renov_pop	Renewal index of working age population (Total 20-29 in Total 55-64)
Mortes_viacao	Killed by 100 car accidents with victims
Acidentes_viacao	Road accidents with victims per thousand inhabitants
Hab_medico_farm	Inhabitants by doctor and pharmacist
TxMort_inf	Child mortality rate
Longevidade	Longevity index
Alunos_total	Students enrolled in pre-school, primary and secondary education, total
Alunos_sup	Students enrolled in higher education, total
Diplomados	Graduates per 100 students enrolled in higher education, total
Est_publicos	Public establishments as % of total establishments in pre-school, primary and secondary education
Docentes_total	Teaching staff in pre-school, primary and secondary education, total
Crimes_total	Crimes recorded by the police per thousand inhabitants
Crimes_pessoas	Crimes recorded by the police (against people)
Crimes_patrimonio	Crimes recorded by the police (against property)
Crimes_sociedade	Crimes recorded by the police (against life in society)
Crimes_Estado	Crimes recorded by the police (against the state)
Cinema	Cinema, spectators per thousand inhabitants
Espectaculos_vivo	Live shows, spectators per thousand inhabitants
Espectaculos_vivo_sessao	Live shows, average number of viewers per session
Galerias	Art galleries and other temporary exhibition spaces, number of spaces
Museus	Museums, total visitors
DespCamaras_Cultura	City Municipal expenses on culture and sport as a % of total expenses
Abstencao_assembRep	Abstention rate in elections for the Assembly of the Republic
Abstencao_Pres	Abstention rate in elections for the Presidency of the Republic
Abstencao_autarquicas	Abstention rate in elections for Local Authorities
Area_ardida	Burnt area
Bombeiros	Firefighters
Despesas_ambiente	Municipal expenses on the environment

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Variables	Description
ONGA	ONGA
Resíduos	Urban waste selectively collected by inhabitants
Drenagem_res	Population served by wastewater drainage systems (%)
Energia_eletrica	Electricity consumption per inhabitant, total
Agua_segura	Safe water — Water quality for human consumption %
Agua_discons	Water distributed/consumed per inhabitant
Superficie	Surface

Source: all data was obtained from EUROSTAT 2021.

Table 3

**Equivalence and meaning of discriminating variables**

Original Variables	English denomination	Description
Pcpercapita	PPpc	Purchasing power per capita
Rec_impostos	Local Tax pc	City municipal tax revenue per capita
Depositos	Bank deposits	Customer deposits at banks, savings banks and mutual agricultural credit banks, total
Credito	Bank credit	Credit granted to customers by banks, savings banks and mutual agricultural credit institutions, total
Ind_aloj	Indiv_house	Average number of individuals per classic family accommodation
Desempregados	Unemployed	Unemployed registered in employment and vocational training centres in the total resident population aged 15 to 64 years (%)
Trab_outrem_Total	Employees	Employees, total
Trab_outrem_sup	Employ HE	Employees with higher education in total, %
Sobrv_empresas_total	Surv_Comp	1-year survival rate of non-financial companies: by sector of economic activity (total)
Longevidade	IL	Longevity index
Diplomados	Graduates	Graduates per 100 students enrolled in higher education, total
Docentes_total	Teachers_Tot	Teaching staff in pre-school, primary and secondary education, total
Crimes_pessoas	Crime_people	Crimes recorded by the police (against people)
Crimes_patrimonio	Crime_prop	Crimes recorded by the police (against property)
Crimes_sociedade	Crime_society	Crimes recorded by the police (against life in society)
Galerias	Galleries	Art galleries and other temporary exhibition spaces, number of spaces
Despesas_ambiente	Envir Expenses	Municipal expenses on the environment
Drenagem_res	Pop wastewater	Population served by wastewater drainage systems (%)
Agua_segura	Water inhabitant	Water distributed/consumed per inhabitant

Source: all data was obtained on EUROSTAT 2021.

**b. The Methods**

In order to obtain the homogenous groups of the Portuguese municipalities and a criterion to discriminate those groups, we applied cluster analysis (CA) to the variables under study and, in a second phase, linear discriminant analysis (LDA) on the obtained clusters in order to identify the discriminant variables of those clusters. Given the high number of variables, we begun to try to obtain factor of each dimension. Given this, we applied Principal Component Analysis (PCA) in order to reduce the number of variables and simultaneously to find the latent dimensions under study. Despite the large number of variables, the level of correlation between them was quite low and the tests for the quality of PCA (KMO tests) indicate

a poor level of variance explained. These results do not allow us to proceed with the exploration of factors, having the need to use the all data set for the CA. Given this, and based on the variety of measure units, we follow the approach of Hair et. al (2014) of performing cluster analysis using standardised variables.

Since we do not have any clue to the number of clusters (and respective constitution), hierarchical clustering was performed. In order to make a correct decision about the number of clusters, several approaches were used to validate results. We utilised Euclidean Distance measures and in term of agglomeration criterion we used: (i) centroid criterion; (ii) average linkage criterion; and, (iii) Ward’s criterion. Due to space restric-



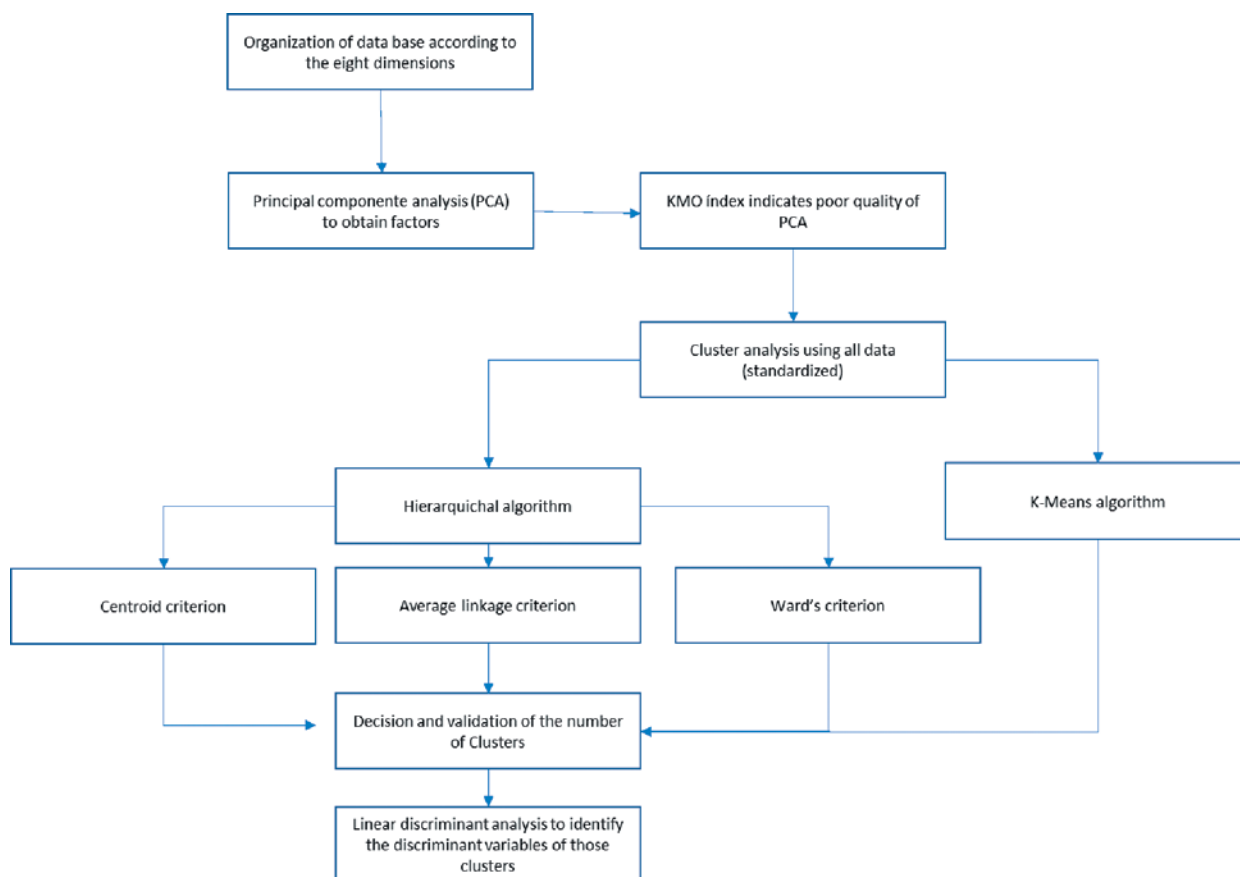


Fig. 1. Methodological steps of the present research work

tions, only the Ward's method results are presented. The results were not different in qualitative terms.

After obtaining the clusters of municipalities, it is important to identify the exact variables that have discriminant power for the constitution of those clusters. In this way, linear discriminant analysis (LDA) was performed. LDA uses a set of variables to predict a categorical variable, which represents the order of the group to which each individual belongs. This technique involves the estimation of a linear combination of independent variables (predictors) – the discriminant functions – that maximises the distance between groups (Hair et. al, 2014). By creating equations that maximise distance and simultaneously minimise the possibility of misclassifying cases in their respective groups or categories, LDA is a useful tool for predicting group membership from a linear combination of variables.

The methodological steps are present in Figure 1.

## 5. Results

This section reports the results obtained through CA and LDA applied to the data in order to cluster the Portuguese municipalities and reveal respective differences.

### a. Cluster Analysis

The cluster analysis was performed to obtain clusters as homogeneous as possible within themselves, and the most distant from each other. In order to properly validate the solutions obtained, the hierarchical algorithm and various agglomeration criteria were applied. We used Euclidean Distance to measure the distance between municipalities using standardised variables. The decision to use this procedure to analyse the variables is justified by the different unit measures (see Hair et. al, 2014). In term of agglomeration criteria, we use centroid methods, average linkage method and Ward's criterion. After that, the K-Means algorithm was also applied. In order to support the decision, the percentage of the sum of squares between groups was calculated against the total sum of squares, in order to evaluate the percentage of the dispersion between groups to the total dispersion, the dendrogram and the elbow graph were also used to support the analyses. For space management reasons, we only present the results obtained with Ward's criterion, however it is important to note that the majority of the different criteria used promote similar results in qualitative terms.

According to the results, the Portuguese municipalities are divided in 3 clusters (Fig. 2).

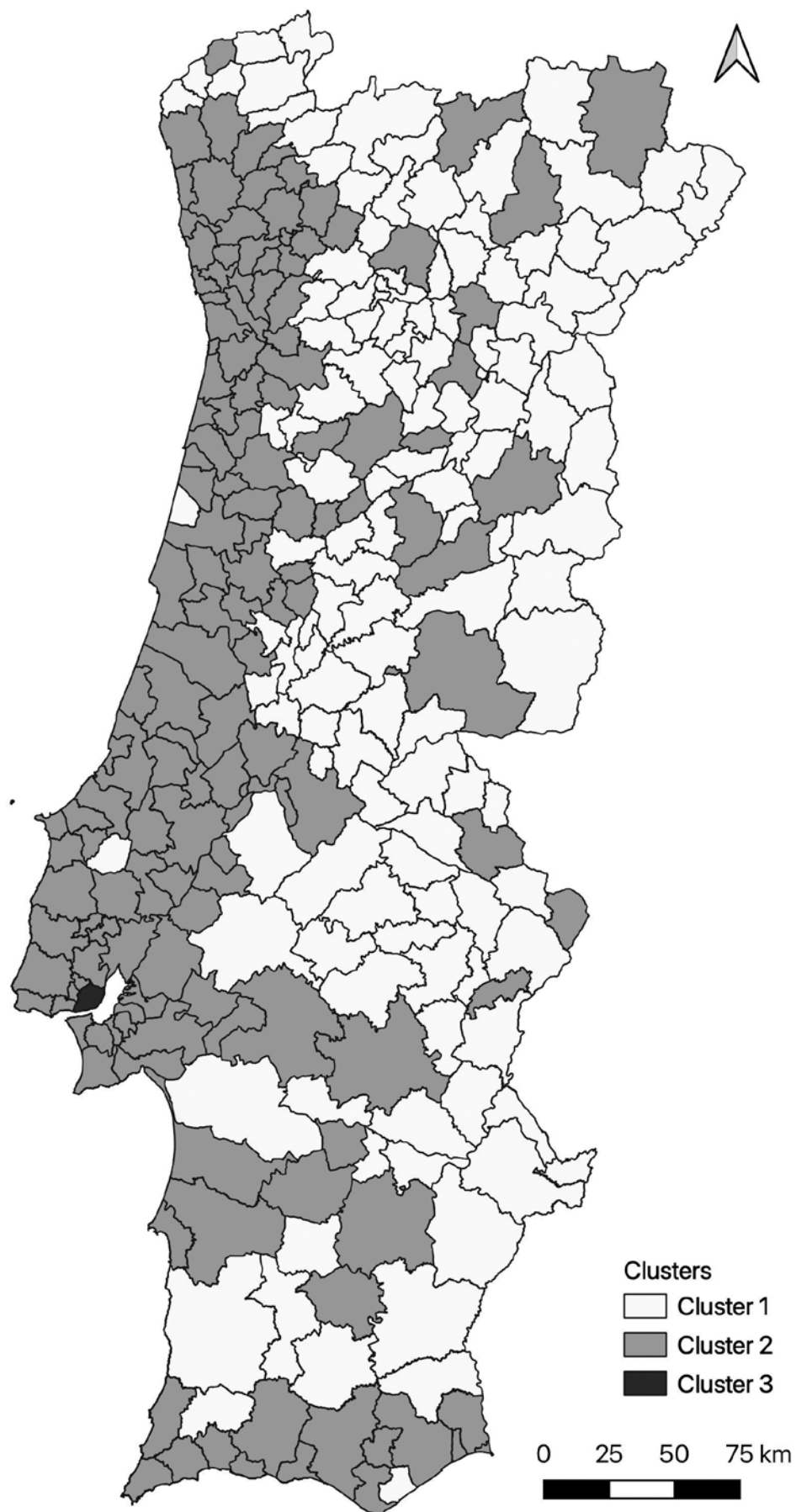


Fig. 2. Clusters of municipalities (source: Author's elaboration)

This approach identifies three different areas of Portuguese territories (considering only the mainland). Cluster 1 includes the majority of inland Portuguese municipalities all over the country, in the distinct geographies; Cluster 2 includes, mostly, coastal municipalities; and Cluster 3 consists of the metropolitan area of Lisbon. These clusters illustrate the diversity of occupation of the territory and, naturally, reflect differences in the population's quality of life. Cluster 1 is the low density area, depopulated and aged territories, from which people and activities have been departing over the last 50 years. Cluster 2 is made up of territories in the coastal region of the country, predominantly between Lisbon and Porto and in the Algarve, to which medium-sized cities along the inland territory are added, which perform the functions of «regional capitals». These territories with greater population density and economic activity have a set of productive, social and cultural activities, provided by public and private entities, which provide a better quality of life for the population. Finally, in an isolated way, the municipality of Lisbon appears in Cluster 3. The country's capital – macrocephalic – this municipality brings together the higher functions of public administration and most private companies, as well as the whole set of less specialised economic and social functions, which naturally react positively to the agglomeration forces created around the larger cities. In statistical terms, and having Cluster Analysis theory as a base (Hair et. al, 2014), one case cannot be the bases to the constitution of one cluster. A cluster must include more than one case. However, in this empirical analysis, we simply could not include the metropolitan area of Lisbon in any other cluster. The differences are so huge and statistically significant, that the only alternative would be to exclude this municipality from the sample, assuming it as an outlier. However, this would be a severe flaw of this research. How could we explain the elimination of the country capital from the database? Given this, we will assume the existence of 3 clusters in the rest of this study, confirming the hypotheses H1 and H2.

Table 4 shows the descriptive statistics for the original variables for each cluster (S.D. is the standard deviation).

There are variables that show great differences between groups, however, this analysis must be based on assumptions of statistical inference. The main variables that seem to determine the differences between the municipalities are strongly related to the economic component; population dynamics and physical security. We can see that all district capitals are part of Cluster 2, except

Lisbon, which is Cluster 3. At first look, we can see that Cluster 3 is clearly away from the other two. In this sense, Clusters 1 and 2 may exhibit some similarities, but Cluster 3 is different and distant in average terms. In fact, Cluster 1 reflects the existence of a set of municipalities with low levels of socio-economic activity, many of which fall within the geographical context of remote rural areas. In these areas, the loss of productive functions associated with traditional activities, especially in agriculture, was not replaced by others capable of retaining population and employment. Cluster 2 includes a set of municipalities with the capacity to promote some retention / attraction of population and employment through the existence of industrial activities, in general, small and medium-sized, or advanced services. Cluster 3, constituted by the country's capital, shows the effect of the agglomeration of economic, social and people activities in this municipality. Although Portugal has benefited, globally, in recent decades from a vast programme of infrastructure creation, supported by EU funds, which aimed to provide the country with the same conditions for attracting residents and productive activities, what happened was the increasing of the agglomeration effect in the capital city and the strengthening, in some cases slight, of medium-sized cities, as opposed to rural territories. Following this trend, the dimensions promoting better quality of life also tend to be concentrated in the most populated areas, despite the trade-off between the benefits of agglomeration and the corresponding congestions.

### *b. Linear Discriminant Analysis*

We have revealed the existence of 3 different clusters. It is important to identify which variables are statistically discriminant between them. The LDA was performed to infer about the variables with discriminating power and to estimate the discriminating functions. The stepwise method based on the Wilks' Lambda was used to identify 19 discriminant variables (see Table 5).

The analysis identifies 19 variables responsible for the differentiation between 3 clusters. The variables that best distinguish the identified clusters are strongly related to the dynamism of economic activity, greater population dynamics and physical security.

Differences in economic activity, occupation of the territory and population dynamics are the domains usually referred to in the literature as being the ones that most distinguish the territories, so these results are in line with others already verified (Rego et. al, 2021; Dionísio & Rego, 2020; Diniz & Sequeira, 2008). Now, it is also veri-

Table 4

**Descriptive statistics for the original variables for each cluster**

	<b>Mean</b>	<b>S.D.</b>	<b>Mean</b>	<b>S.D.</b>	<b>Mean</b>
Pcpercapita	70.09	8.27	89.98	16.98	219.6
Ganho_mensal_trab	889.52	77.95	1033.58	189.53	1616.1
Rec_impuestos	85.86	25.42	146.72	78.20	241.1
Benfef_RSI	3.13	2.00	2.19	1.20	4.6
BenfSDes	0.80	0.38	0.71	0.40	0.5
Depositos	202393.40	130358.60	958563.00	1539678.41	66667662.0
Credito	91862.25	71901.29	865363.15	2513343.75	86585962.0
Ind_aloj	1.29	0.24	1.74	0.36	1.6
Desempregados	5.67	2.17	4.20	1.29	5.6
Trab_outrem_Total	2406.53	2280.58	15716.04	18936.74	410527.0
Trab_outrem_sup	0.13	0.03	0.15	0.05	0.4
Trab_outrem_parcial	105.09	113.29	1106.94	1776.84	42687.0
Oferta_emplo	19.81	29.24	96.63	109.09	679.0
Sal_min_rem_media	-169.04	52.67	-279.52	147.99	-739.0
Sobrv_empresas_total	79.42	5.31	76.71	3.71	76.0
Sobrv_empresas_agricpescas	74.00	10.48	73.81	12.49	71.6
Sobrv_empresas_industria	86.44	9.71	83.29	7.34	83.3
Sobrv_empresas_Serviços	80.08	5.88	76.28	4.08	75.8
Produtividade	15935.68	6258.97	21266.23	6902.70	35940.7
Alojamento	34.31	36.08	46.55	123.93	127.9
Renov_pop	0.71	0.10	0.79	0.11	0.7
Mortes_viacao	3.57	4.91	1.68	1.57	0.3
Acidentes_viacao	3.32	1.16	3.69	0.88	5.4
Hab_medico_farm	588.28	195.05	399.63	207.56	52.4
TxMort_inf	3.49	9.67	2.23	2.91	1.9
Longevidade	56.00	4.14	48.64	4.27	54.0
Alunos_total	1557.78	1459.75	8908.44	10062.12	118076.0
Alunos_sup	22.60	98.57	1927.43	6566.27	118590.0
Diplomados	1.08	4.59	8.99	13.18	21.8
Est_publicos	73.98	32.91	68.81	24.61	40.8
Docentes_total	167.58	133.01	773.19	817.10	9861.0
Crimes_total	24.48	6.38	26.51	8.60	49.7
Crimes_pessoas	95.60	80.79	453.71	501.18	5548.0
Crimes_patrimonio	129.81	144.96	895.96	1278.26	22326.0
Crimes_sociedade	57.11	40.16	205.43	202.94	3380.0
Crimes_Estado	4.05	5.35	25.20	29.66	543.0
Cinema	19.58	44.86	151.55	263.61	0.0
Espectaculos_vivo	552.58	1257.95	1144.91	2114.71	5959.9
Espectaculos_vivo_sessao	157.75	311.41	294.96	334.97	402.6
Galerias	1.59	1.14	4.08	5.67	146.0
Museus	5716.96	12812.72	86167.06	407588.45	5401722.0
DespCamaras_Cultura	11.33	4.99	11.19	4.65	7.3
Abstencao_assembRep	50.70	5.63	46.11	4.94	39.7
Abstencao_Pres	62.83	5.62	55.73	4.85	46.7
Abstencao_autarquicas	37.49	6.36	43.66	7.70	48.8
Area_ardida	197.40	308.94	97.36	196.17	4.0
Bombeiros	63.79	36.23	118.24	98.42	1069.0
Despesas_ambiente	850.19	537.32	3280.01	4728.68	79967.0
ONGA	0.13	0.37	0.41	0.77	24.0
Residuos	64.29	49.79	100.55	73.18	186.6
Drenagem_res	73.93	22.10	77.61	21.67	100.0
Energia_eletrica	4028.18	3223.74	5622.35	8369.64	5972.6

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	Mean	S.D.	Mean	S.D.	Mean
Agua_segura	98.14	1.44	99.46	0.72	99.2
Agua_discons	54.94	19.48	62.88	32.28	158.7
Superficie	21.07	22.22	14.83	20.11	0.2

Source: Own elaboration.

Table 5

## Wilks' Lambda and ANOVA F statistic for the discriminant variables

	Tolerance	Wilks' Lambda	F statistic	p-value
Depositos	0.011	0.019	1471.07	0.00
Docentes_total	0.019	0.004	125.13	0.00
Credito	0.018	0.009	938.87	0.00
Longevidade	0.368	0.003	80.36	0.00
Desempregados	0.803	0.003	20.64	0.00
Crimes_patrimonio	0.034	0.003	243.91	0.00
Pcpercapita	0.299	0.003	96.42	0.00
Agua_segura	0.905	0.003	42.01	0.00
Rec_impostos	0.423	0.003	25.84	0.00
Trab_outrem_sup	0.492	0.003	19.51	0.00
Despesas_ambiente	0.272	0.003	224.55	0.00
Trab_outrem_Total	0.072	0.003	373.72	0.00
Ind_aloj	0.292	0.003	50.68	0.00
Drenagem_res	0.691	0.003	1.34	0.00
Galerias	0.22	0.003	502.80	0.00
Crimes_pessoas	0.023	0.003	106.93	0.00
Crimes_sociedade	0.082	0.002	219.84	0.00
Sobrv_empresas_total	0.763	0.003	10.19	0.00
Diplomados	0.651	0.002	15.31	0.00

Source: Own elaboration.

fied that security is a domain that appears as a differentiator for Portuguese municipalities. This result is very interesting, since it is common sense that a higher density of occupation is usually associated with a higher incidence of crime. These results seem to correspond with this perception. However, it is impossible to ignore that low density areas are also vulnerable spaces and targets of criminal actions, precisely because the lower surveillance levels.

According to the results of LDA regarding the quality of global classification, 93.3 % of the cases are correctly classified. These results confirm the robustness of the analysis performed (see Table 6).

The Box-M test was performed and the null of homogeneity of group variances was rejected. The main reason for this result is the difference between clusters sizes, as we have a cluster with one municipality. In the light of statistical theory, an individual (in this case, a municipality) is not one cluster. Although, besides this theoretical feature, all the results point to the exclusion of Lisbon from all the others clusters. Given this, and respecting the "data voice", we decide to let a cluster with one observation.

## Quality of global classification

Table 6

	Clusters	Predicted Group Membership			Total
		1	2	3	
Original Count	1	99	7	0	106
	2	10	136	0	146
	3	0	0	1	1
%	1	93.4	6.6	0	100
	2	6.8	93.2	0	100
	3	0	0	100	100

Source: Own elaboration.

The results indicate that the variables related to dynamism of economic activity, greater population dynamics and physical security are the ones that most contribute to the discrimination between the 3 groups of municipalities found, confirming hypothesis H3. These results corroborate other studies (Christodoulou et. al, 2008; Gonzalez et. al, 2011; Rego et. al, 2021). It is worth mentioning that Gonzalez et. al (2011) used different analysis methods (Data Envelopment Analysis), although the study also concludes that the variables related to economic and social dynamics, longev-

ity and population density are those that best define quality of life in the municipalities. These results, in addition to corresponding to other similar studies with the same type of methodology, have been discussed (and also reinforced), as well as their social and political effects, in the recent literature on «discontented territories» (Oliveira Martins, 2021; Rodríguez-Pose, 2018).

## 6. Final Considerations

This paper studies the differences in quality of life in Portuguese municipalities based on a wide range of variables available in the national statistics, which are freely accessible. Data, always collected for the most recent year in which they were available, were treated with multivariate statistical methods, in particular, cluster analysis. The option for this technique allows the identification of groups of territories with common characteristics throughout the country.

The cluster analysis allowed the identification of 3 groups of municipalities with clearly distinct characteristics. The municipalities in the innermost areas (Cluster 1), close to the Spanish border, are characterised by the low density of human and economic occupation. The municipalities in the coastal zone between Lisbon and Porto, the Algarve and “regional capitals” constitute Cluster 2. In this case, the municipalities in question presented levels of population occupation, economic activity and provision of goods and services — economic, social and cultural — that ensure a reasonable quality of life for the populations, and, in some cases, they are promoters of the surrounding regions. The municipality of Lisbon appears as Cluster 3. Isolated, this municipality is far from the whole country and thus presents the strong agglomeration constituted by the central functions of the country’s capital.

The obtained results allow us to achieve the objective defined for this work, namely that by knowing what groups and what distinguishes the Portuguese municipalities in terms of variables of the various dimensions of quality of life, it was possible to obtain a clear map based on these similarities and differences.

These findings show the importance of economic activity and population dynamics in distinguishing groups of municipalities, which means that, with a view of reducing asymmetries in the quality of life between Portuguese municipalities, public policy should develop measures to minimise differences in these areas. In particular, the importance of supporting employment, business and entrepreneurship becomes evident, as well as encouraging education with a view to increasing

per capita income, in order to bring the regions closer together.

In addition, the results also show that the areas with more activity are also those with the highest level of crime. This evidence may limit the population’s perception of safety, which is why this area should also deserve particular attention from public decision-makers. As is well known, security issues have become increasingly important, constituting a factor of attraction or repulsion of a territory.

The fact that the results of this study confirm others already obtained for previous periods, reveals that public policies, aimed at improving the cohesion of the territory, as they have been applied, have not been efficient to reduce the differences, in some domains of quality of life analysis, between the municipalities of distinct clusters (H4 is aligned with this conclusion). As has also been pointed out in other studies (e.g. Rego et. al, 2021), that the implementation of place-based policies could be the way for public policy to better react to the needs of different territories, in different geographies, aiming at a global improvement in quality of life. Once the location of population and the economic dynamic walk together, the public policy should reinforce the territorial capabilities to attract and retain employment, namely through improving knowledge, innovation, technologies transference, and to strengthen the competitiveness of the municipalities that, at the moment, are (almost) left behind.

As is well known, the choice of variables can influence the results obtained. One of the limitations of the study is the availability of variables to analyse Portuguese municipalities, since there are fewer data for municipalities than for NUTS III and II and for studying Portugal as a whole. This study, being developed only based on variables that can be freely obtained in the statistical system, allows its replication. Furthermore, this scale of analysis allows for a more detailed study of territorial diversity. In fact, only with studies on a more detailed scale, such as this one, is it possible to get to know the territory better and, from there, to design effective public policies with greater potential for success to mitigate the differences in the various domains of quality of life.

Finally, it is expected that future works, in line with this one, will propose guidelines for the creation of a system of statistical indicators for monitoring and evaluating quality of life in Portuguese municipalities, which will be of great importance for public decision-makers, technicians and citizens, on issues related to the quality of life of municipal inhabitants.

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