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REVISTA PORTUGUESA DE ESTUDOS REGIONAIS

PORTUGUESE REVIEW OF REGIONAL STUDIES

1º Quadrimestre | nº 70 | Avulso €15

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APDR
ASSOCIAÇÃO PORTUGUESA PARA O DESENVOLVIMENTO REGIONAL

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Going Big in a Small Country: Fifty Years of Motorways in Portugal

Crescer num País Pequeno: Cinquenta Anos de Autoestradas em Portugal

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Abstract

Portugal's motorway network experienced significant transformation in a relatively short period. Until the mid-1980s, the network counted less than 200 kilometers, reaching more than 3 000 kilometers in the end of this decade of the 21st century. As a result of this strong investment, the country now has one of the largest and densest motorway networks in the European Union. This paper describes the methodology developed for the construction of a longitudinal spatial database covering 50 years of road improvements in mainland Portugal using the Geographic Information Systems environment technology. Besides containing information for different road networks, the database also includes administrative, demographic, and socioeconomic information for Portugal's mainland municipalities. Using the new database developed by the authors, the paper analyzes the evolution of the motorway network and the road-based accessibility to population and jobs over the period from 1971 to 2020. The new database is publicly available to other researchers and will, hopefully, be used in future studies on the socioeconomic impacts of road investments in Portugal, for example, to understand how improved road accessibility contributed to regional economic development or regional cohesion.

Keywords: Motorways; Road Accessibility; Portugal; Geographic Information Systems.

JEL Codes: R40; R41; R42

Resumo

A rede de autoestradas em Portugal sofreu uma transformação significativa num período relativamente reduzido. Até meados dos anos 80, a rede de autoestradas atingia menos de 200 quilómetros, em contraste com os mais de 3 000 quilómetros de extensão no final desta década do século XXI. Como resultado deste forte investimento, o país passou a dispor de uma das maiores e mais densas redes de autoestradas da União Europeia. Este artigo descreve assim, a metodologia desenvolvida para a construção de uma base de dados longitudinal, abrangendo 50 anos de melhorias contínuas ao nível rodoviário em Portugal Continental, recorrendo aos Sistemas de Informação Geográfica. Além da informação relacionada com as diferentes infraestruturas rodoviárias, a base de dados inclui também informação administrativa, demográfica e socioeconómica dos diversos municípios de Portugal Continental. Com esta nova base de dados desenvolvida, o artigo analisa a evolução da rede de autoestradas, assim como, a acessibilidade rodoviária à população e empregos no período entre 1971 e 2020. Esta nova fonte de informação está disponível ao público, assim como, investigadores que pretendam aceder, possibilitando estudos futuros sobre os impactos socioeconómicos dos investimentos rodoviários em Portugal, como exemplo, a melhoria da acessibilidade rodoviária no desenvolvimento económico e coesão regional.

Palavras-chave: Autoestradas; Acessibilidade Rodoviária; Portugal; Sistemas de Informação Geográfica.

Códigos JEL: R40; R41; R42

1. INTRODUCTION

Motorways in Portugal were almost non-existent during most of the 20th century. Until the mid-1980s, the motorway network counted less than 200 kilometers and was essentially limited to parts of the suburban areas of the two metropolitan areas of Lisbon and Porto. However, after joining the now European Union (EU) in 1986, the country gained access to European regional development funding, which was, in part, allocated to improving roads and building motorways. The contribution of European funds to the total investment in infrastructure, of which transport represented more than 50% of total investment, varied across the different financial frameworks: it accounted for 38% of total investment in the QCA I (1989-93), 60% in the QCA II (1994-99), 57% in the QCA III (2000-06), and 64% in the QREN (2007-13) according to Pereira (2013). Referring data from Pereira and Pereira (2016), in the period between 1980 and 2011, road investment represented about 29% of total investment in infrastructure (four times larger than the investment in railways), while motorways represented about 7% of total investment in infrastructure. The share of the investment effort in motorways increased over time, from 2.6% of total investment in infrastructure in the 1980s to 6.8% in the 1990s and 11.7% in the 2000s.

The motorway network increased from only 75 km in 1971 to about 3 164 km in 2020, which corresponds to an annual average growth rate of 7.9% over the entire period. The periods between 1991-2001 and 2001-2011 saw the largest construction of motorways, 1 114 km and 1 213 km, respectively. The network was essentially completed in 2013, with only minor changes taking place since then (e.g., some road connections to motorways and short sections of some motorway corridors). As a result of this strong investment, the country now has one of the largest and densest motorway networks in the EU. According to Eurostat data for 2020, Portugal has the fifth largest motorway network in absolute terms in the EU: only the much larger countries of Spain, Germany, France, and Italy have a larger motorway network than Portugal. If we consider the total length of motorways in relation to GDP, population, and area, Portugal ranks second, third, and fifth, respectively.

This paper has two main objectives. The first objective is to describe the construction of the longitudinal spatial database, named "TiTuSS Transport Database", for mainland Portugal's road network between 1971 and 2020 at ten-year intervals. The database is available in the cloud-based

communal repository Mendeley Data and published as Afonso et al. (2023)[1]; see Appendix A for the list of variables. To obtain an internally consistent georeferenced longitudinal database, it was necessary to perform several validation tests for the integrity of the different road networks, as well as multiple quality control procedures. The paper can thus be seen as an extended manual supporting future uses of the resulting database. The second objective is to analyze how patterns of road accessibility have changed across municipalities over this 50-year period.

The database can be used to study a wide range of economic effects of roads, particularly of motorways, on the spatial economy. Improvements to transport infrastructure reduce transport costs and improve accessibility to input (i.e., suppliers, labour, etc.) and output markets, producing several impacts on the economy. These effects include, among other factors, the expansion and integration of wider markets, leading to productivity gains from improved labour supply and specialization; higher efficiency through scale economies and economic restructuring due to firm entry and exit resulting from stronger competition; and other productivity effects from spatial agglomeration economies. There are several review studies of the economic effects of transport infrastructure (e.g., Boarnet, 1997; Melo et al., 2013; Melo, 2021). The reduction in transport costs and improved accessibility can also influence the distribution of people and jobs both between and within regions, which in turn affects regional cohesion.

Importantly, the literature suggests that motorways contribute to the growth of local population and employment (e.g., Duranton and Turner, 2012; Percoco, 2016), the shifting population from central cities to their suburbs (e.g., Baum-Snow, 2007a; Baum-Snow, 2007b; Garcia-López, 2012; Garcia-López et al., 2015), and urban sprawl (e.g., Deng et al., 2008; Müller et al., 2010; Oueslati et al., 2015; Ahrens and Lyons, 2019; Garcia-López, 2019; Pratama et al., 2022). Our database already contributed to providing new evidence for Portugal on the role of motorways on local population growth and suburbanisation (e.g., Rocha et al., 2023) and local economic activity (e.g., Rocha et al., 2024), and we hope it can foster further research.

The paper is organized as follows. Section 2 provides an overview of the methodology adopted and of the sources of the road network data used. Section 3 describes the processes underlying the construction of the longitudinal spatial database, including the validation of the quality of the road networks (i.e., motorways, expressways, as well as national, regional, and municipal roads) in each period and their harmonization across the different periods. Section 4 describes the expansion of motorways, expressways, and the extent of motorway accessibility to population and jobs during the period of analysis. Section 5 presents some final considerations.

2. DATA AND METHODOLOGY

The diagram in Figure 1 describes the overall methodology and specific procedures undertaken using a Geographic Information Systems (GIS) environment based on version 10.8 of the ArcGIS platform marketed by ESRI (ESRI, 2022). As depicted in the figure, the creation of the georeferenced longitudinal database considered as inputs data for the road networks covering the period from 1971 to 2020 at ten-year intervals, as well as other spatial and tabular information referring to demographic and socio-economic data from the decennial population censuses. Therefore, in Figure 1, we have represented two main frames showing the specific input data and processing tasks. In the top frame, we show the data and operations relating to the construction of the road network database, whereas in the bottom frame we show the operations referring to the spatial and tabular socioeconomic data obtained from the population censuses.

The left box of the top frame shows the road network data collected. Given the different formats of the baseline road maps (digital vector formats and paper maps), several spatial processing tasks had to be performed on the data obtained from public entities and private institutions, notably: Portugal Infrastructures (IP), a state-owned company responsible for the management of the country's road network (except municipal roads) and rail network; the Army Geospatial Information Center (CIGeoE), which is an official provider of geographic/geospatial information; the Portuguese Automobile Club (ACP), the oldest motoring club in Portugal with more than 100 years and owner of a large collection of historic road maps; and *TomTom-TeleAtlas*, a Dutch multinational company specialized on the development of global location technology and one of the most important retailers

[1] Available at: https://data.mendeley.com/datasets/ry5dkty7t7.

of car satellite navigation worldwide. The tabular data associated with the road databases includes the following main attributes: type of road link, length of road link, road identifier, year of opening, and the legal speed limit. The right box of the top frame highlights the main validation procedures carried out on the tabular information, including updates, edits, topological operations, and the generation of a routing grid covering all the Portugal mainland. The grid is composed of square cells with a 500-meter length and an attributed speed of 10 km/h, and was built to support and improve route assignments, as to ensure a proper connection between municipality centroids and the road network. This routing grid was essential for the more accurate calculation of the travel time/distances between all pairs of centroids. The GIS-based models of the different road and motorway networks were then assembled in geodatabases and evaluated for their integrity, essentially through operations of vectorization, calibration, and topological analysis, which we discuss in Section 3.

The left and right boxes of the bottom frame show the spatial and tabular data obtained from the Directorate-General of the Territory (DGT), a government entity that is responsible for the establishment of standards and references in several domains (e.g., geographic information, geodesy, mapping, and land registry), and Statistics Portugal (INE), the official entity for statistics in Portugal. These data include geospatial information containing the administrative boundaries for municipalities, as recorded in the DGT's Official Administrative Map of Portugal (CAOP), their respective centroids, census population data obtained at the geographic level of the minimum subdivision of the census spatial database – the Geographic Base of Information Referencing (BGRI) –, as well as employment data collected also from the decennial censuses. We used population-weighted centroids based on the spatial distribution of the population within each municipality (instead of geographic centroids) to compute road distances and travel times between municipalities. Although mainland Portugal has 278 municipalities, to ensure data consistency across the time horizon studied, we use the pre-1998 administrative division, i.e., 275 municipalities. The integration of the GIS-based road network with this information allowed us to develop several indicators of road accessibility for population and jobs at the municipality level (see Section 4).

Figure 1. Methodology underlying the construction of the TiTuSS Transport Database

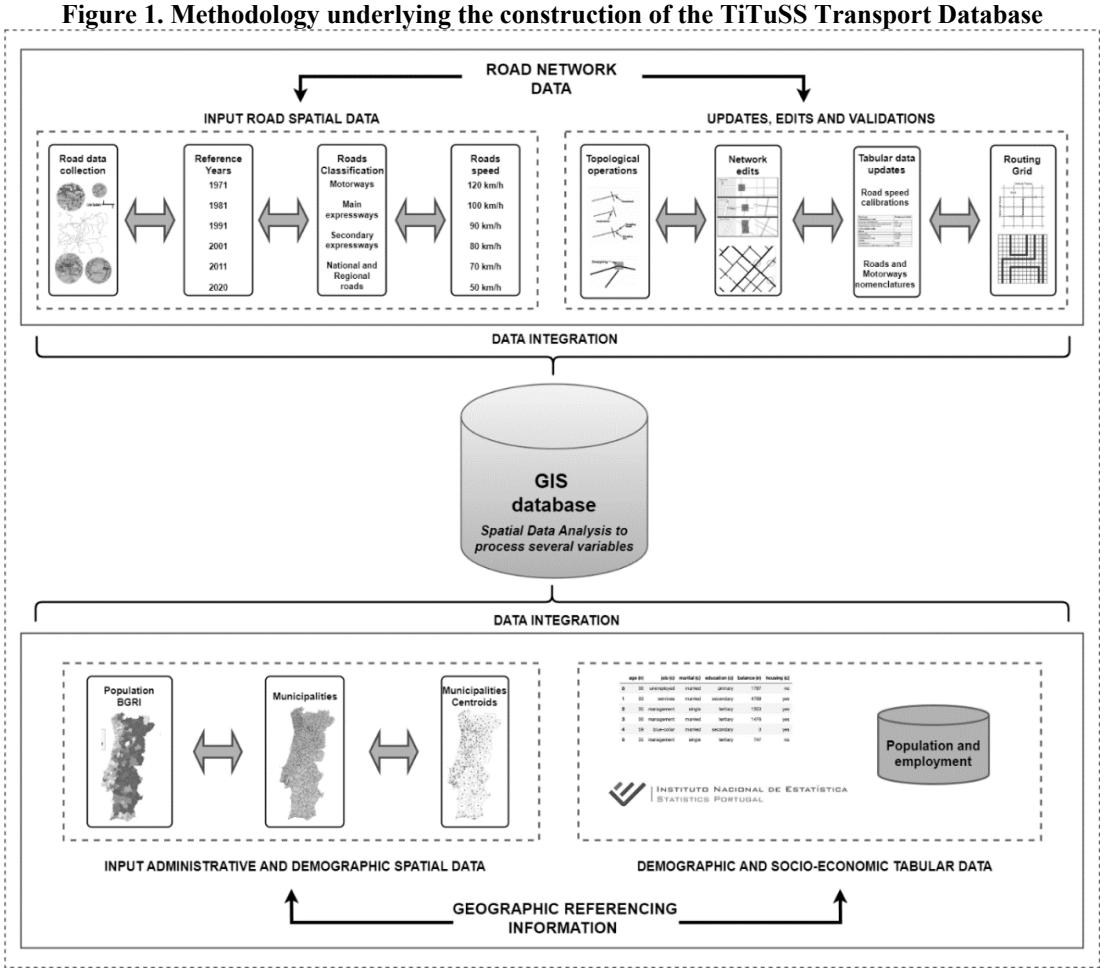


Table 1 presents the data sources and formats for each reference period. As noted above, road maps came from different entities and were in various formats, more specifically, vector format (e.g., CAD and *shapefile* format) and paper format in the case of the maps published by the Portuguese Automobile Club (ACP) for the 1970s and 1980s, which required further scanning, vectorization, and editing. The digital vector format road maps were sourced from public entities, namely the Army Geospatial Information Center (CIGeoE) and Portugal Infrastructures (IP), as well as from a private sector company, *TomTom-TeleAtlas*. In addition to these sources, we also used data from the open-source geographic database *OpenStreetMap* (OSM)[2], maintained and updated by a collaborative project, where data are collected from surveys, aerial imagery, and other free licensed geodata.

Table 1. Summary of the sources and formats of the road mapping information

Years	Road map information	Format	Source
1998	Primary	Digital (*.shp** and *.dwg** formats)	CIGeoE
1991, 2001, 2011	Primary	Digital (*.shp* format)	TomTom-TeleAtlas
1971, 1981	Auxiliary	Paper / Digital (*.pdf*)	ACP
2020	Auxiliary	Digital (*.shp* format)	IP
Various from 2004	Auxiliary	Digital (*.shp* format)	OSM

*Note: *native digital vector proprietary formats. The shapefile format (.shp), developed by ESRI, is interoperable with most GIS software packages and stores geographic and associated tabular attributes information, whereas the drawing (.dwg) format, developed by Autodesk, is native for several CAD applications, including AutoCAD.*

Given the multiple sources of road network information, we made the following decisions. The construction of the 1981 road network was primarily based on downgrading operations of the digital vector map from CIGeoE referring to the year 1998. The 1971 road network was then built from the 1981 network, after the validation of the necessary downgrades. The road networks for 1991, 2001, and 2011 were primarily based on maps from *TomTom-TeleAtlas*, which were already available for each of those years. The construction of the 2020 road network was based on the 2011 network after the validation of the necessary upgrades. The road networks obtained from ACP, IP, and OSM were used as auxiliary sources in the construction of the road networks in each period with the specific purpose of complementing information from the primary sources previously described. They provided useful information for the processes of verification, validation, and integration of the different networks, notably the operations of upgrading and downgrading for the 2020 and 1971 networks respectively.

In addition to the road mapping information in Table 1, we also considered information about the different road networks compiled in a technical study produced by Portuguese scholars, Sousa et al. (2011), who analyzed the evolution of the road network from 1983 to 2009. More specifically, the maps illustrating the most relevant updates of the road network were used to visually verify their agreement with the road networks we edited, especially the road networks referring to 1991 and 2001.

3. CONSTRUCTION AND VALIDATION OF THE ROAD NETWORKS

This section describes the various procedures undertaken to produce a single harmonized and internally coherent sequence of road networks covering the period from 1971 to 2020. Following the overall approach depicted in Figure 1, we carried out several measures to ensure the resulting georeferenced longitudinal road networks are valid for analyses of road--based accessibility.

[2] Data for Portugal obtained from: https://download.geofabrik.de/europe/portugal.html.

3.1. Road typologies and free-flow speeds

The classification of roads changed over the timeline of the study according to the prevailing National Road Plan (PRN). The first PRN dates from 1945, as published in the Decree-Law 34593 (1945), and was revised by the PRN 1985, that is, the Decree-Law 380 (1985), and the PRN 2000, that is, the Decree-Law 222 (1998), which is still in effect today. According to the current national road plan, the National Road Network is composed by the Fundamental National Network, which contains the principal routes (IPs), and the Complementary National Network, which contains the secondary routes (ICs) and national roads. The majority of IPs and many ICs make up the motorway network, in which case their designation starts by the letter A referring to "Autoestrada" (i.e., motorway in Portuguese). IPs, ICs, national, and regional roads are managed at the level of central government by Portugal Infrastructures, while municipal roads are managed at the local level by municipalities. The types of roads considered in our study are summarized in Table 2 and can be described as follows:

- *Motorways:* these roads have physically separated carriageways (dual carriageway), each with at least two traffic lanes, and grade separated junctions. Motorways comprise a great part of principal routes (IPs) and several secondary routes (ICs). These roads are restricted to motorized vehicles with a minimum of 50 cylinder capacity (cc).
- *Expressways (Main and Secondary)*: these roads also have dual carriageway, each with at least two traffic lanes. Yet, these characteristics are recommended and not mandatory, i.e., some of these roads may have single carriageway with three or two lanes, or even dual carriageway with three lanes or two lanes (one by each direction). Road junctions tend to be grade separated; however, in some specific situations at-grade road crossings could be allowed. For the purposes of our database, we consider that main expressways are those that are part of the principal routes (IPs), while secondary expressways are part of the secondary routes (ICs). We exclude from this class a few expressways which already have a reserved motorway label and include them in the *Motorway* type group. Expressways are also restricted to motorized vehicles with a minimum of 50 cc.
- *National Roads:* these roads constitute the second component of the Complementary National Network, covering all the country beyond the *Expressways* and *Motorways.* Normally, these types of roads have a single carriageway with two traffic lanes (one by each direction) and level crossings (road intersections). However, in specific situations they could have more than two traffic lanes, dual carriageway and grade separated junctions. An example could be ring or outer circular roads in urban or suburban areas, as well as other corridors with heavy traffic volumes. The free-flow speed considered on these roads can vary depending on the road's terrain and pavement conditions.
- *Regional Roads:* these roads have supra-municipal interest and are complementary to the *National Roads*. They generally have lower speed limits than national roads. Furthermore, similarly to national roads, some of their segments may also include dual carriageway, and grade separated junctions. Likewise, the free-flow speed considered can also vary depending on the road's terrain and pavement conditions.
- *Municipal/Local roads:* these roads are the sole responsibility of municipalities. They include the roads connecting different civil parishes and these with the seat of the municipality, as well as other roads inside urban areas. The speed limit can vary depending on the urban context and road conditions; for example, speeds inside urban areas are generally limited to 50 km/h. In addition, they may also include dual carriageway (with two or more traffic lanes), and grade separated junctions. Given the massive number and capillarity of municipal roads, and the fact that many were built to serve rural, forested areas and small hamlets, our analysis considers the municipal roads that correspond to urban connections (e.g., city streets and avenues) in metropolitan areas and in other urban areas. Overall, this corresponds to about 1/3 of the total length of municipal roads in Portugal.

The speed limits associated with each type of road were assigned to each respective road segment in the GIS database according to what is established in each PRN. These speeds were treated as free-flow (i.e., assuming no road congestion) and were used in the computations of travel times (after the

validation process described in Section 3.2) along the road network between each pair of municipalities. Table 2 shows the road classification and the reference free-flow speeds used.

Table 2. Classification of roads and free-flow speeds by type of road

Classification	Picture	Dual Carriageway	Reference free-flow speed (km/h)
Motorways		Yes	120
Main / Secondary Expressways	  	Yes No	100 90 to 100
National Roads		No	70 to 90
Regional Roads		No	70 to 80
Municipal / Local Roads	  	No Yes	50 to 70 70 to 80

Note: Pictures sourced from Portugal Infrastructures (IP) and Wikimedia Commons (WC).

3.2. Validation tests and quality control procedures

3.2.1 Adjustments and updates of free-flow speeds

The main purpose of this process consisted in the verification, update, and validation of the free-flow speed limits (see Table 2) in the different periods of analysis. Given the long timespan of the period studied, many roads were improved (e.g. road category upgrades or rehabilitation works) and thus had to have their speed limits updated over the years. In addition, several speed limit rectifications had to be performed. Since the road mapping information for different periods comes from different sources, there were differences in the level of detail for each road section. Those small differences were rectified through harmonizing the free-flow speeds in the problematic road segments. In addition, in some cases the maximum legal speed limits attributed to each road type had to be adjusted to take account of speed limitations due to adverse topographical conditions. Therefore, in some areas (mainly in the North region), road speeds were reduced from the original speed by 40% due to the terrain topography. To be more precise, we superimposed a terrain basemap on the road network to identify the municipalities with an Average Terrain Elevation (ATE) greater

than 500 meters, and then selected the road sections that needed to have their road speed limits reduced.

3.2.2 Topological network analysis

The topological analysis carried out evaluated the logical consistency of the spatial data, notably the existence of integrity and connectivity in the spatial relationships and between the road networks referring to the different time periods. According to ESRI (2021), the verification of logical consistency requires that the data are topologically correct and follows a set of rules to enable the GIS database to more accurately model geometric relationships. This analysis was carried out for each period of the study using ESRI's *ArcGIS* spatial tool *Topology* which is based on a set of rules of integrity and topological behavior (for more details see Appendix B).

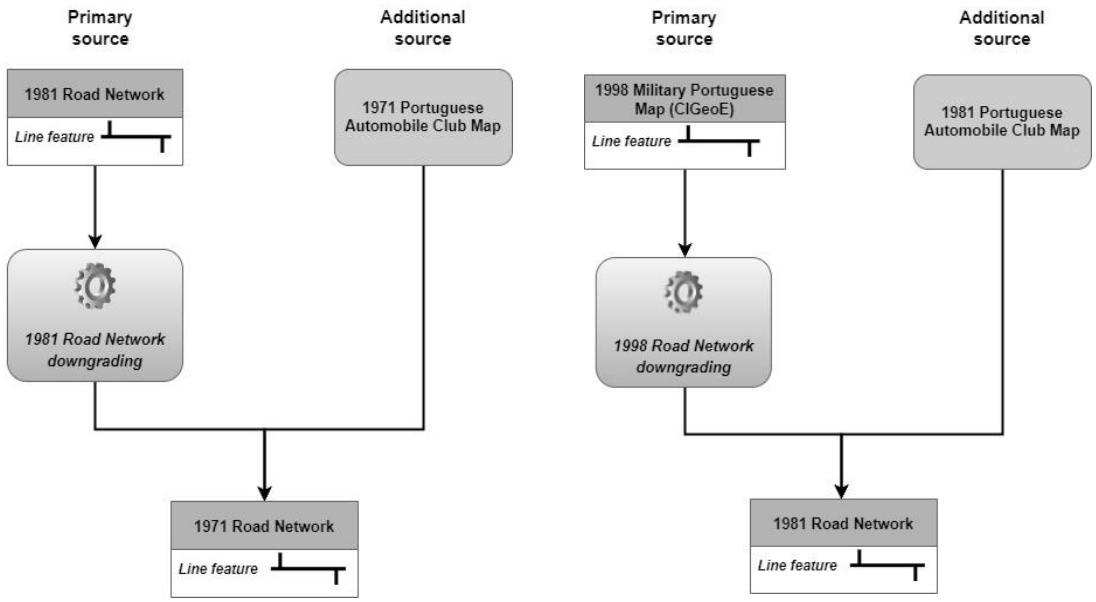
3.3. Road networks construction methodology

3.3.1 The road networks of 1971 and 1981

Figure 2 shows the workflow of the construction of the 1971 and 1981 road networks. The construction of the road network for 1971 was implemented by applying downgrading operations to the road network of 1981. This basically consisted of deleting or shortening the road sections present in the 1981 digital vector road network, but which were inexistent in 1971. Downgrading operations were supported by the information contained in the attributes table of the 1981 digital vector road network, which indicated the year of opening of each road section. In addition, we used supplementary information from existing road maps from the Portuguese Automobile Club (ACP) for 1971. Moreover, verification tests of the shortest path and total travel times between each pair of municipalities were made using the network and the routing grid created for this purpose.

The construction of the 1981 road network was fundamentally based on the reference GIS-based road map obtained from the Army Geospatial Information Center (CIGeoE) referring to the year 1998 (see Table 1). A series of downgrading edits were carried out based on information about the opening year of road sections in the attribute table associated with the CIGeoE map. The resulting road map for 1981 was then compared to the ACP paper format road map for 1981.

Figure 2. Workflow of the construction of the road networks in 1971 (left) and 1981 (right)



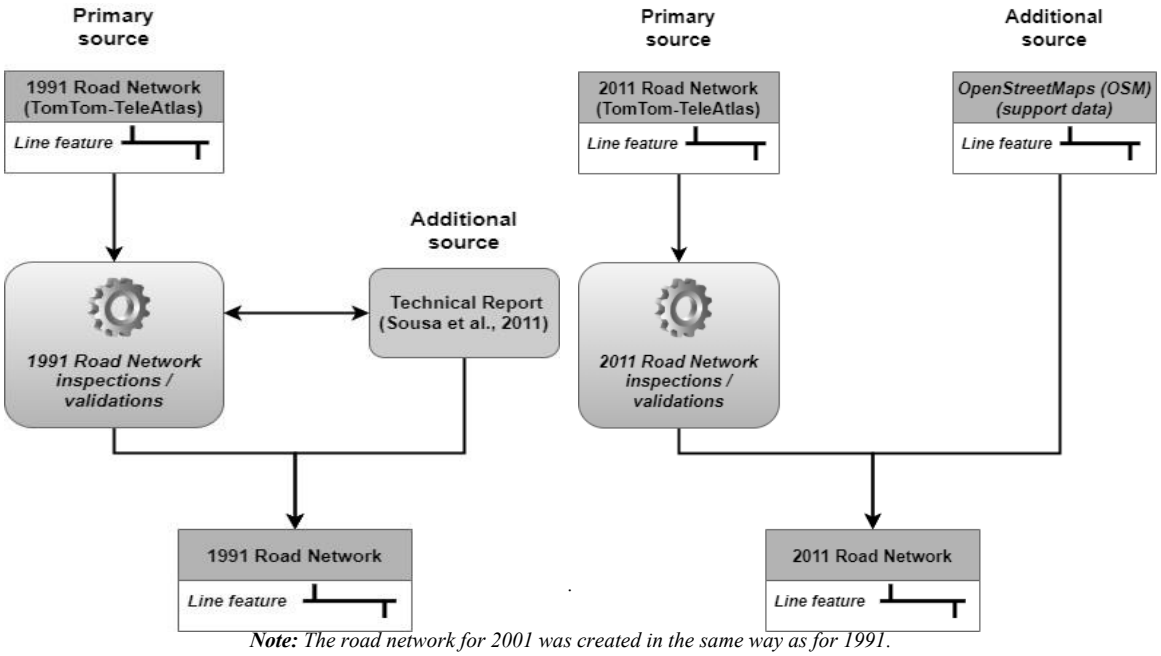
3.3.2 The road networks of 1991, 2001, and 2011

The road networks for the years 1991, 2001, and 2011 were derived from reference maps obtained from *TomTom-TeleAtlas* (see Table 1). To ensure comparability between the road networks for these years and the 1971 and 1981 road networks, we first applied a coordinate system transformation between primary sources to overcome the difference between the military coordinate system and the coordinate systems used in georeferenced maps produced by non-military entities. The maps were then overlapped with each other, assessed for comparability, and revised for coherence.

Figure 3 shows the workflow of the construction of the 1991 and 2011 road networks. Since the road network data for 2001 was evaluated and validated in the same way as for 1991, we present the workflow only for the years 1991 and 2011. The construction of the road network for 1991 was based exclusively on the *TomTom-TeleAtlas* road maps for that year. The network data was evaluated according to its integrity and validated using a set of quality control operations to identify network inconsistencies, including the occasional implementation of small vectorizations in the vector map and updates to the tabular information in the respective attribute table. Verification tests for the shortest path and total travel times between each pair of municipalities using the routing grid created were also implemented. In addition, we also used the documentation provided by Sousa et al. (2011) to compare our networks to those produced by the authors.

The construction of the road network for the year 2011 followed the same approach as for the year 1991 and 2001, and, in addition, included checking for necessary updates (or possible downgrades) based on information from the open-source geographic database OSM.

Figure 3. Workflow of the construction of the road networks in 1991 (left) and 2011 (right)

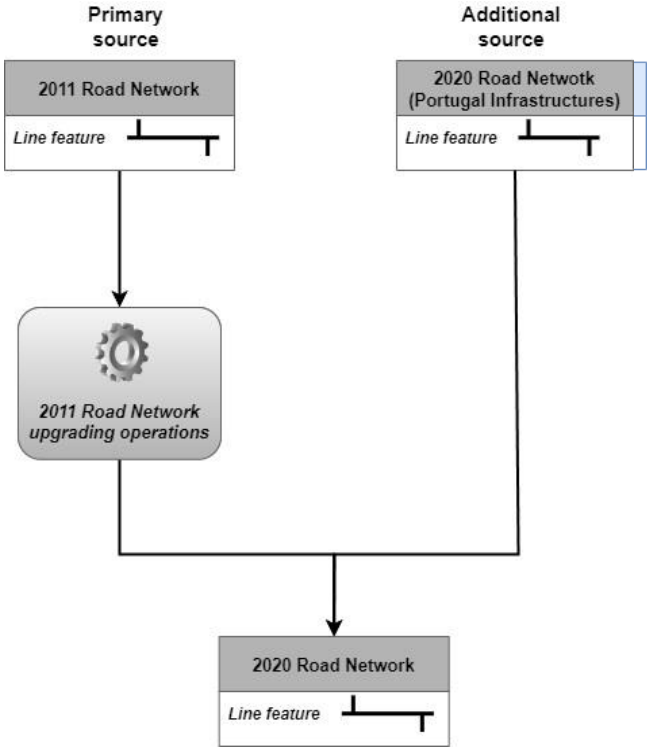


Note: *The road network for 2001 was created in the same way as for 1991.*

3.3.3 The road network of 2020

Figure 4 shows the workflow of the construction of the 2020 road network. The primary source was the 2011 road network obtained following the workflow described in Figure 3, which served as the basis for the upgrading operations referring to the motorways and expressways identified from the auxiliary vector road map for 2020 (see Table 1) obtained from Portugal Infrastructures (IP).

Figure 4. Workflow of the construction of the road network in 2020



4. EVOLUTION OF MOTORWAYS, EXPRESSWAYS, AND ROAD ACCESSIBILITY TO PEOPLE AND JOBS

This section presents a brief description of the changes occurred in motorways and expressways between 1971 and 2020 and the consequent improvements in road-based accessibility to people and jobs.

Figure 5 shows the expansion of motorways and expressways in Portugal over the period. In 1971 and 1981, both motorways and expressways were practically inexistent (in 1971, motorways and expressways added up 75 km and 5 km, respectively), and largely limited to the metropolitan areas of Lisbon and Porto. Regarding the Sines region (a town in the south west of the country), the main reason for the early development of accessibilities was the expansion of the Sines deep-water port area, and the growth of other related industrial projects, namely the installation of the petrochemical industrial park and the coal thermoelectric central. In 1981, there were around 162 km of motorways and 29 km of expressways, representing an annual average growth rate (AAGR) of 8.0% and 19.2%, respectively, from 1971.

Between 1981 and 1991, the network experienced considerable expansion. The main corridor of the motorway network, the A1 motorway linking Lisbon to Porto, was completed in 1991. Regarding main expressways (IPs), the fully operational IP5 (Aveiro/Vilar Formoso) – an important international west-east corridor –, the north section of IP4 (Amarante/Vila Real) and the interior central region IP2 section (Castelo Branco/Fratel) were the most notable advances. The length of motorways and expressways reached 550 km and 444 km in 1991, representing an AAGR from 1981 of 13.0% and 31.4%, respectively.

The length of motorways and expressways continued to increase at a substantial pace between 1991 and 2001, reaching 1 664 km (i.e., an AAGR of 11.7%) and 920 km (7.6%) respectively. This period saw the completion of some important connections to Spain, namely, the west-east motorway corridors A6 (Lisboa/Elvas) and A22 (Albufeira/Vila Real de Santo António), this last one in the southeast region, as well as the A3 motorway between Porto and Valença. There were other relevant advances, notably the completion of some important main expressways, such as the IP3 (Coimbra/Viseu) and IP4 (up to Bragança), as well as the improvement in connections to low-density regions in the interior of the country, e.g., the sections of IP2 (Portalegre/Estremoz). Regarding secondary expressways (ICs), the IC8 (Pombal/Proença-a-Nova) was a relevant advance.

The length of motorways and expressways reached 2 877 km and 1 107 km in 2011, corresponding to an AAGR of 5.6% and 1.9% from 2001, respectively. This corresponds to the period in which the motorway network approached a consolidated state, after the completion of important north--south motorway corridors connections, like the A2 (Lisboa/Albufeira) and A24 (Chaves/Viseu), as well as of the A22 south west-east corridor (Lagos/Vila Real de Santo António). Moreover, new motorway sections were constructed in the (already well-served) metropolitan areas of Lisbon and Porto and along the coast between these two regions. Additionally, some main expressways were also upgraded to motorway status during this period, namely the A25 (Aveiro/Vilar Formoso) – formerly IP5 – and the A23 (Torres Novas/Guarda), upgraded from the former IP2. At the expressways level, the conclusion of the north section of IP2 (Macedo de Cavaleiros/Trancoso) was the most relevant improvement. Finally, the evolution from 2011 to 2020 was rather small; in fact, the motorway network almost stopped growing after 2013 when the motorway network was essentially completed. The main improvements in the motorway network during this period were the completion of the A4 (Porto/Bragança) in the northeast region (mostly from the upgrade of IP4) and the A13 (Tomar/Coimbra) in the centre region. Concerning expressways, connections (of already existing IPs and ICs) in the west-east (centre and northeast regions) and south interior corridors were also concluded. The length of motorways and expressways in 2020 was 3 164 km and 1 141 km, corresponding to an AAGR from 2011 of 1.1% and 0.3%, respectively.

The total motorway length (3 164 km) corresponds to approximately 100 km more than the official value reported by Eurostat. The difference can be mainly explained by the definition of motorways used in this study, which assumes that all expressways (IPs and ICs) that meet certain specifications (i.e., speeds of 120 km/h and other specifications described in Section 3.1.) and have a reserved motorway label should effectively be treated as motorways.

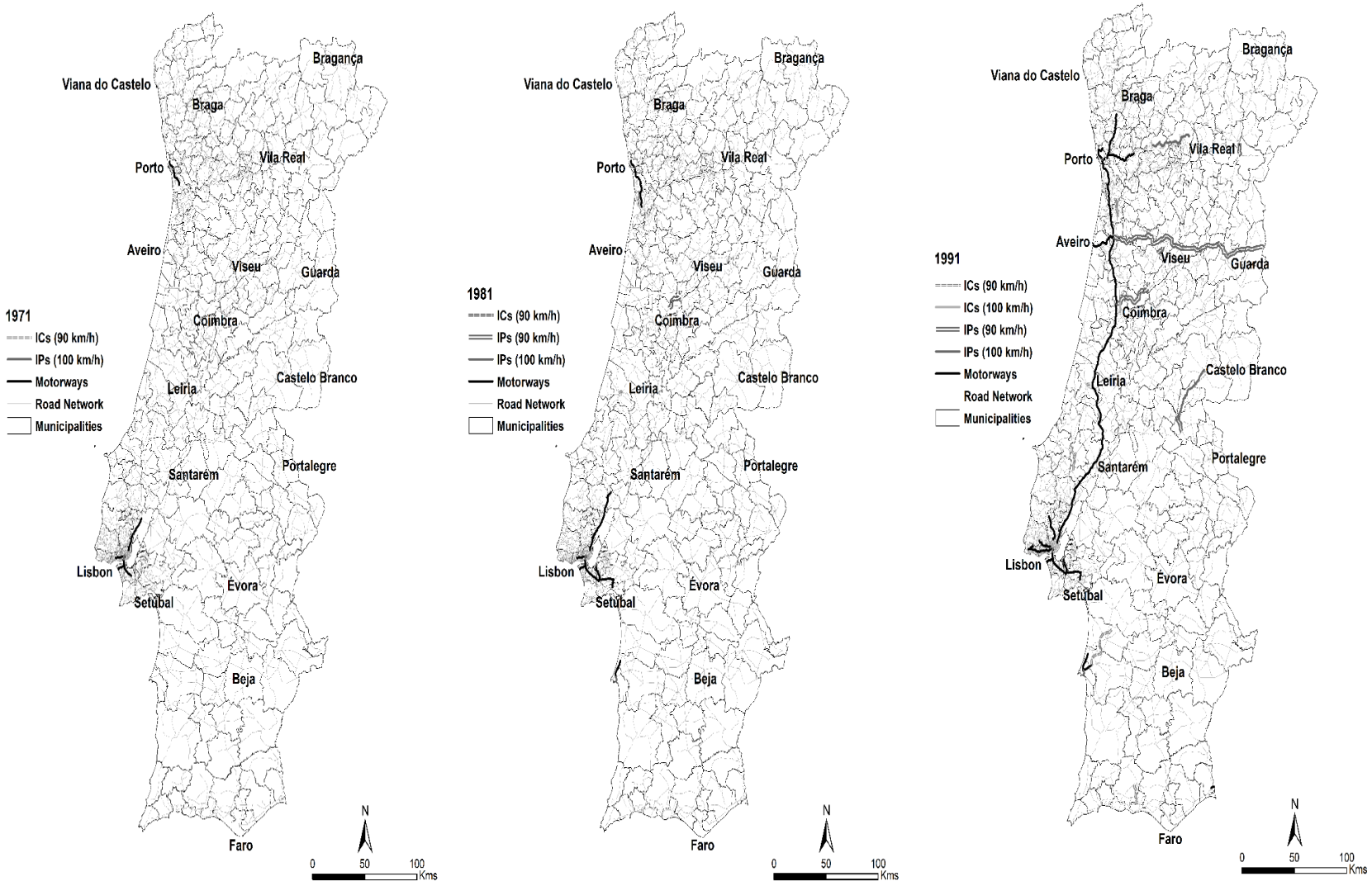
Table 3 presents a summary of basic descriptive statistics for the measures of road and motorway accessibility, namely: length of motorways and expressways, number of motorway access ramps, distance to the nearest motorway access ramp, the shares of municipalities, population, and jobs with access to a motorway ramp within a certain travel time, and an indicator of market potential for both population and jobs. The indicator of market potential is described in equation (1). The measures of road-based distance and travel time used in the computation of our indicators were calculated using 1981 population-weighted centroids for all municipalities. Data for population and jobs were obtained from the population census.

$$MP_i = \sum_{j \neq i} \frac{O_j}{c_{ij}} \qquad (1)$$

MP_i denotes the potential population (or jobs) accessible to municipality i, and consists of the summation of the population ($O_j = POP_j$) or jobs ($O_j = JOB_j$) in each municipality j, discounted for the travel time ($c_{ij} = tt_{ij}$) or road distance ($c_{ij} = dis_{ij}$) between each pair of municipalities i and j. The travel times tt_{ij} and road distances dis_{ij} were computed using the municipality's 1981 population-weighted centroids, as referred previously. The indicator of market potential captures the combined effects of economic mass (measured either by population or jobs) and road improvements (measured in the origin-destination road distances and travel times). For a full list of the variables included in the database, see Appendix A.

Table 3 shows that the size of the motorway network improved massively during the last two decades of the 20th century, as depicted in the maps of Figure 5. These improvements are reflected in the substantial reduction of the average distance to the nearest motorway access ramp, which in 1971 was 118 km, falling to 96 km in 1981, 65 km in 1991, 26 km in 2001, 20 km in 2011, and 16 km in 2020. Expressways also increased substantially, but there is considerable variation across typologies. Secondary expressways (ICs) limited to 100 km/h grew significantly only after 2011 due to improvements in technical standards carried out on this type of roads. This explains the reduction in the total length of secondary expressways limited to 90 km/h between 2011 and 2020, as some of these were upgraded to 100 km/h. As for the main expressways (IPs), the observed reduction in their length in the later periods of 2011 (for IPs limited to 90 km/h) and 2020 (for IPs limited to 100 km/h) can be explained by the upgrading of some IPs to motorway status.

Figure 5. Evolution of motorways and expressways in Portugal between 1971 and 2020



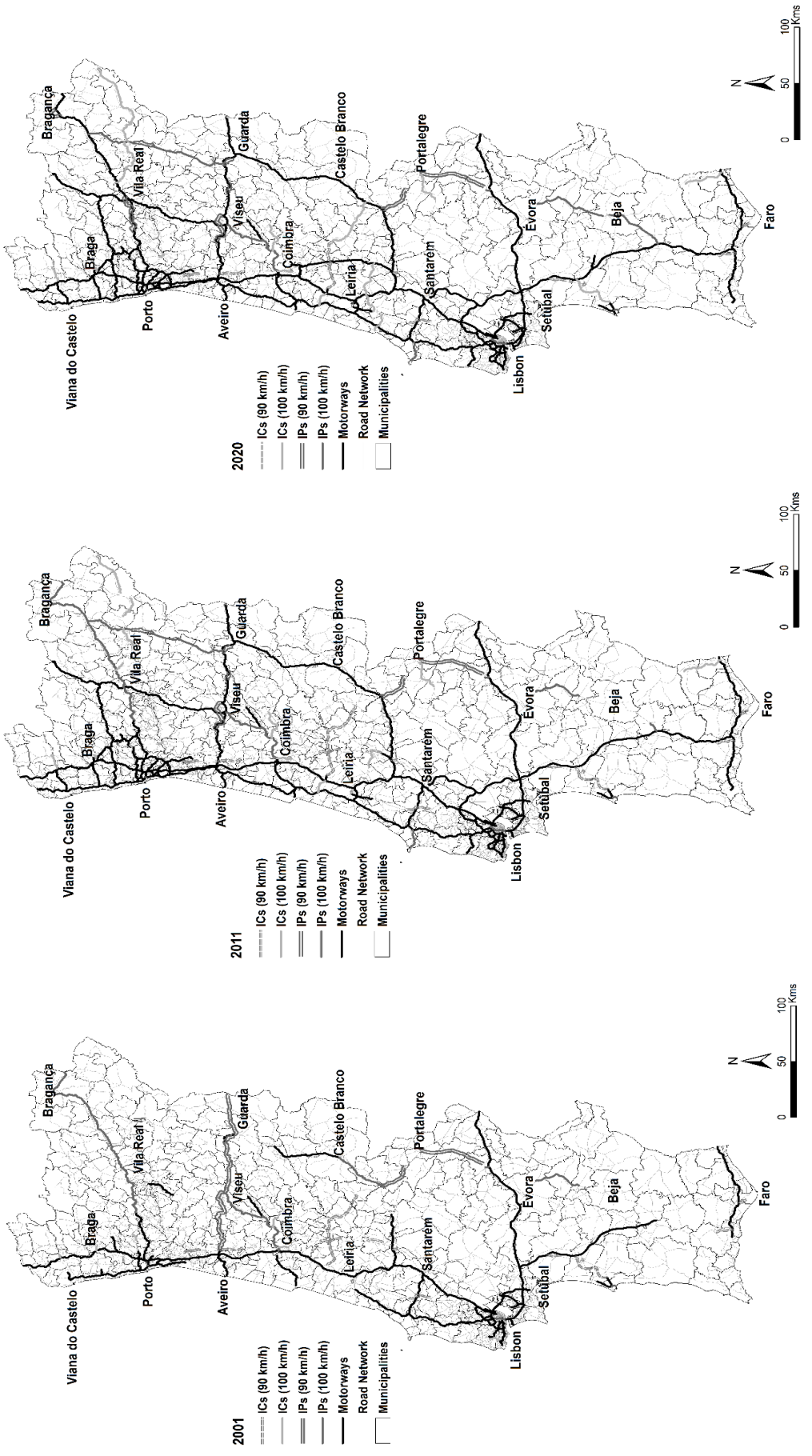


Figure 5. Evolution of motorways and expressways in Portugal between 1971 and 2020 (cont.)

As expected, we also observe strong improvements in the territorial coverage of motorways and the extent of the total population and jobs served by motorways. Up to 1981, less than 10% of the municipalities were within 15 minutes of the nearest motorway access ramp, rising to almost 20% in 1991, 44% in 2001, 56% in 2011, and 61% in 2020. If we consider 30 minutes as the reference, in 1981 only 16% of the municipalities had access to a motorway in that time band, rising to 32% in 1991, 69% in 2001, 79% in 2011, and 82% in 2020. In 1981, less than 30% of the municipalities were within 60 minutes to the nearest motorway, in contrast to more than 50% in 1991, and more than 90% in 2001, reaching 96% and 98% in 2011 and 2020, respectively. In other words, at the beginning of the 21st century already nearly all municipalities were within 60 minutes of a motorway access ramp and over 2/3 were within 30 minutes.

The increase in the coverage of the population served by motorways is also notable. Up to 1981, less than 1/3 of the population was within 15 minutes to the nearest motorway ramp; the share exceeded 50% by 1991, reaching 75% in 2011, 84% in 2011, and 86% in 2020. If we consider instead the population within 30 minutes to the nearest motorway, we observe that nearly all the population had access to motorways after 2001 – i.e., 91%, 95%, and 96% in 2001, 2011, and 2020 respectively –, which is in great contrast to only 35% of the population in 1971, rising to 44% and 63% in 1981 and 1991, respectively. Motorway access levels are much larger for the 45- and 60-minutes time intervals.

Regarding the coverage of jobs, the analysis could only be done for the years from 1991 to 2020, due to lack of data for the previous years. In 1991 we already have one of the most important axis of the motorway network concluded – i.e., the A1-A3 corridor connecting Lisbon to Porto (and almost to Braga), as shown in Figure 5. This corresponds to the regions with the greater concentration of jobs, which helps explain why in 1991 we have already 71% of jobs within 15 minutes from the nearest motorway ramp. This percentage increased to 91% in 2001, 95% in 2011, and 96% in 2020. Considering the share of jobs within 30 minutes to the nearest motorway, we observe that in 1991 almost 80% of jobs had access to motorways, with nearly full coverage being achieved in the following years: 96% in 2001, 98% in 2011, and 99% in 2020. The share of jobs within 45 minutes or 60 minutes from the nearest motorway was already very high in 1991, i.e. 83% and 86% respectively, reaching practically 100% from 2001 onwards.

Concerning market potential, this gravity measure was computed according to equation (1) to evaluate accessibility to population and jobs (only from 1991 onwards) in each year of analysis. The values reported in Table 3 represent the simple mean and median values of market potential across municipalities, calculated using both the travel time and road distance between municipalities. Given the reported improvements in the road network, we expect both road distances and travel times to have reduced over the period across municipalities, but the direction of change in population (and jobs) is less obvious and will vary across municipalities. Consequently, the overall effect reflected in the value of market potential is not self-evident. We observe that the mean and median values of the market potential indicator tend to increase over the period, except for 2020. Given the limited change in road accessibility between 2011 and 2020, the slight decrease in the mean and median values of the market potential may reflect the reduction in population size by 1.9% between 2011 and 2021, according the 2021 population census. Given the very heterogeneous performance across mainland municipalities, it is important to assess the change in the value of the market potential indicator for different regions of the country, contrasting urban with rural areas, coastal with interior areas, etc. This, however, is not within the scope of this paper, but is an interesting avenue for future research.

Table 3: Summary statistics of the variables included in the longitudinal spatial database

	1971	1981	1991	2001	2011	2020
Length of motorways (km)	77	164	552	1 673	2 886	3 173
Number of motorway access ramps	63	86	187	515	761	822
Average distance to nearest motorway access ramp (km)*	118	96	65	26	20	16
Length of main expressways, 100 km/h (km)	3	6	97	365	435	322
Length of secondary expressways, 100 km/h (km)	0	0	8	38	247	431
Length of main expressways, 90 km/h (km)	0	18	247	263	157	215
Length of secondary expressways, 90 km/h (km)	2	5	92	254	268	173
Share of municipalities within* …						
15 min to nearest motorway access ramp (%)	5	9	18	44	56	61
30 min to nearest motorway access ramp (%)	11	16	32	69	79	82
45 min to nearest motorway access ramp (%)	17	21	43	85	92	95
60 min to nearest motorway access ramp (%)	22	28	55	92	96	98
Share of population within* …						
15 min to nearest motorway access ramp (%)	26	33	52	75	84	86
30 min to nearest motorway access ramp (%)	35	44	63	91	95	96
45 min to nearest motorway access ramp (%)	43	50	73	96	98	99
60 min to nearest motorway access ramp (%)	47	58	81	97	99	100
Share of jobs within* …						
15 min to nearest motorway access ramp (%)	-	-	71	91	95	96
30 min to nearest motorway access ramp (%)	-	-	78	96	98	99
45 min to nearest motorway access ramp (%)	-	-	83	98	99	100
60 min to nearest motorway access ramp (%)	-	-	86	99	100	100
Market Potential values, for population accessibility*….						
Mean, considering travel time	54851	66195	79080	97201	106461	105338
Median, considering travel time	53127	61851	73552	91555	100643	99219
Mean, considering road distance	59033	67960	66613	69719	71140	69721
Median, considering road distance	59769	67034	64145	66327	66613	64899
Market Potential values, for jobs accessibility*….						
Mean, considering travel time	-	-	33298	44289	44061	42681
Median, considering travel time	-	-	30059	40627	41013	39675
Mean, considering road distance	-	-	27665	31401	29203	28042
Median, considering road distance	-	-	25564	28447	26307	25132

*Note: *calculations based on the municipality population-weighted centroids of 1981.*

5. FINAL CONSIDERATIONS

This work described the methodology and quality control procedures implemented to build a new longitudinal spatial database which integrates information for the road networks with demographic, administrative, and socioeconomic information for the municipalities of mainland Portugal over the period from 1971 to 2020. The resulting database can be used to study the effects of improved road accessibility on multiple socioeconomic outcomes in Portugal (e.g., population growth/decline, employment growth/decline, regional cohesion, urbanization patterns, etc.) over a considerable long period of 50 years.

Portugal's road network experienced a strong investment in motorways and expressways after the 1980s, especially after the country joined the now EU and gained access to European regional

development funding to improve its public capital infrastructure, as mentioned in Pereira and Pereira (2016). There are previous works to ours that also constructed spatial databases of road networks for Portugal, namely, Sousa et al. (2011) and Cruz et al. (2021). Our work adds to these existing databases in several ways. We consider a longer period by including data for 1971 and the more recent years 2011 and 2020. Similarly to Cruz et al. (2021), our database from Afonso et al. (2023) is publicly available for free, in contrast to the database produced by Sousa et al. (2011) which is not publicly available. There are also differences in terms of the transport indicators developed and the geographical units to which they refer. The database produced by Cruz et al. (2021) considers a wider range of transport indicators, referring, among others, to road and rail access to the main airports and ports in mainland Portugal in the period from 1981 to 2019, but the indicators are provided only at the level of NUTS III regions, which correspond to aggregations of municipalities.

Although the database and analysis presented in this study refer to the road network, we have also developed simple measures of the railway network, namely the number of active railway stations in each municipality and the road-based distance and travel time to the nearest active railway station, which are also included in our database. We hope to release new versions of the database in the future that include more detailed measures of rail accessibility. In contrast to the large expansion of motorways and expressways in this period, railways experienced strong disinvestment, both in terms of line closures and lack of upgrading of the infrastructure. Portugal has one of the least dense and least competitive passenger railway networks in the EU and is the only non-island country with a motorway network larger than the railway network. Between 1971 and 2020, more than 1 000 km of railways were closed, corresponding to about 29% of the network.

REFERENCES

Afonso, N., Melo, P.C., Rocha, B.T., de Abreu e Silva, J. (2023), "TiTuSS Transport Database", Mendeley Data, V2. doi: 10.17632/ry5dkty7t7.1. Available at: https://data.mendeley.com/datasets/ry5dkty7t7

Ahrens, A., Lyons, S. (2019), "Changes in Land Cover and Urban Sprawl in Ireland From a Comparative Perspective Over 1990–2012", Land, Vol.8(1), nº16. doi: https://doi.org/10.3390/land8010016

Baum-Snow, N. (2007a), "Did Highways Cause Suburbanization?", Quarterly Journal of Economics, Vol. 122(2), pp. 775-805. Available at: http://www.jstor.org/stable/25098858

Baum-Snow, N. (2007b), "Suburbanization and Transportation in the Monocentric Model", Journal of Urban Economics, Vol. 62(3), pp. 405-423. doi: https://doi.org/10.1016/j.jue.2006.11.006

Boarnet, M.G. (1997), "Highways and Economic Productivity: Interpreting Recent Evidence", Journal of Planning and Literature, Vol. 11, pp. 476–486. doi: https://journals.sagepub.com/doi/10.1177/088541229701100402

Cruz, C. O., Costa, Á., Faria e Sousa, V., Januário, J., and Miranda Sarmento, J. (2021), Sistemas de Transportes em Portugal: Análise de Eficiência e Impacto Regional, Fundação Francisco Manuel dos Santos, ISBN: 978-989-9064-33-1. Available at: https://www.ffms.pt/pt-pt/estudos/sistemas-de-transportes-em-portugal

Decree-Law L34593 (1945), Decreto-Lei no 34593 de 11 de Maio do Ministério das Obras Públicas e Comunicações - Gabinete do Ministro, Diário do Governo No 102/1945, 1º Suplemento, Série I de 1945-05-11, pp. 373-394. Available at: https://dre.pt/dre/detalhe/decreto-lei/34593-1945-241850?_ts=1674518400034.

Decree-Law 380 (1985), Decreto-Lei no 380/85 de 26 de setembro, do Ministério do Equipamento Social, Diário da República No 222/1985, Série I de 1985-09-26, pp. 3206-3214 Baum-Snow, 2007a. Available at: https://dre.pt/dre/detalhe/decreto-lei/380-1985-176998.

Decree-Law 222 (1998), Decreto-Lei no 222/98, de 17 de julho, do Ministério do Equipamento, do Planeamento e da Administração do Território, Diário da República No 163/1998, Série I-A de 1998-07-17, pp. 3444-3454. Available at: https://dre.pt/dre/detalhe/decreto-lei/222-1998-424689

Deng, X., Huang, J., Rozelle, S., Uchida, E. (2008), "Growth, Population and Industrialization, and Urban Land Expansion of China", Journal of Urban Economics, Vol. 63, pp. 96-115. doi: https://doi.org/10.1016/j.jue.2006.12.006

ESRI (2021), Homepage of ESRI Geodatabase Topology — ArcGIS Desktop Documentation. Available at: https://desktop.arcgis.com/en/arcmap/latest/manage-data/editing-topology/geodatabase-topology-rules-and-topology-error-fixes.htm

ESRI (2022), Homepage of ESRI ArcGIS Desktop Documentation. Available at: https://desktop.arcgis.com/en/arcmap/latest/get-started/introduction/whats-new-in- arcgis.htm

Garcia-López, M., (2012), "Urban Spatial Structure, Suburbanization and Transportation in Barcelona", Journal of Urban Economics, Vol. 72(2-3), pp. 176-190. doi: https://doi.org/10.1016/j.jue.2012.05.003

Garcia-López, M., Adelheid, H., and Viladecans-Marsal, E. (2015), "Suburbanization and Highways in Spain when the Romans and the Bourbons Still Shape its Cities", Journal of Urban Economics, Vol. 85, pp. 52-67. doi: https://doi.org/10.1016/j.jue.2014.11.002

Garcia-López, M., (2019), "All Roads Lead to Rome … and to Sprawl? Evidence from European Cities", Regional Science and Urban Economics, Vol. 79, 103467. doi: https://doi.org/10.1016/j.regsciurbeco.2019.103467

Duranton, G. and Turner, M.A. (2012), "Urban Growth and Transportation", Review of Economic Studies, Vol. 79(4), pp. 1407-1440. Available at: https://matthewturner.org/papers/published/Duranton_Turner_RES_2012.pdf

Melo, P.C. (2021), "Transport Infrastructure Effects on Economic Output: The Micro-Economic Approach" in Vickerman, Roger (eds.) International Encyclopaedia of Transportation, Vol. 1, pp. 347-354. United Kingdom, Elsevier Ltd.

Melo, P.C., Graham, D.J., Brage-Ardao, R. (2013), "The Productivity of Transport Infrastructure Investment: a Meta-Analysis of Empirical Evidence", Regional Science and Urban Economics, Vol. 43(5), pp. 695–706. doi: https://doi.org/10.1016/j.regsciurbeco.2013.05.002

Müller, K., Steinmeier, C., Küchler, M. (2010), "Urban Growth Along Motorways in Switzerland. Landscape and Urban Planning", Vol. 98, pp. 3–12. doi: https://doi.org/10.1016/j.landurbplan.2010.07.004

Oueslati, W., Alvanides, S., Garrod, G. (2015), "Determinants of Urban Sprawl in European Cities", Urban Studies, Vol. 52, pp. 1594–1614. doi: https://doi.org/10.1177/0042098015577773

Pereira, A.M. (2013), Os Investimentos Públicos em Portugal, Fundação Francisco Manuel dos Santos, ISBN: 9789898662170, Lisbon.

Pereira, A.M. and Pereira, R.M. (2016), Investimentos em Infra-estruturas em Portugal,Fundação Francisco Manuel dos Santos, ISBN: 978-989-8838-56-8. Available at: https://www.ffms.pt/pt-pt/estudos/investimento-em-infraestruturas-em-portugal

Pratama, A.P., Yudhistira, M.H., Koomen, E. (2022), "Highway Expansion and Urban Sprawl in the Jakarta Metropolitan Area", Land Use Policy, Vol. 112, 105856. doi: https://doi.org/10.1016/j.landusepol.2021.105856

Rocha, B.T., Melo, P.C., Afonso, N. and de Abreu e Silva, J. (2023), "The Local Impacts of Building a Large Motorway Network: Urban Growth, Suburbanisation, and Agglomeration", Economics of Transportation, Vol. 34, pp. 100-302. doi: https://doi.org/10.1016/j.ecotra.2023.100302

Rocha, B.T., Melo, P.C., Afonso, N. and de Abreu e Silva, J. (2024), "Motorways, Local Economic Activity and Commuting", Regional Studies, Vol. 58(1), pp. 164-177, doi: https://doi.org/10.1080/00343404.2023.2187768

Sousa, J., Fernandes, A., Galiau, S., Estêvão, M., and Antunes, G. (2011), A Evolução dos Transportes e Acessibilidades e as Transformações na Organização do Território, Instituto de Dinâmica do Espaço, ISBN: 978-989-97245-0-1. Available at: http://hdl.handle.net/10362/11795

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APPENDIX A

Table A.1. Variables in the database developed by Afonso et al. (2023), described in this study

Variable		Variable definition	Units	Years
Identifier variables	OID	Object identifier for municipalities	N/A	Time-invariant
	YEAR	Year of analysis	N/A	1971-2020
	NUTS2	NUTS II region (Nomenclature of Territorial Units)	N/A	Time-invariant
	NUTS3	NUTS III region (Nomenclature of Territorial Units)	N/A	Time-invariant
	DT81	Official administrative code of district according to the territorial division of 1981	N/A	Time-invariant
	DTCC81	Official administrative code of municipality according to the territorial division of 1981	N/A	Time-invariant
	DISTRICT	Name of district	N/A	Time-invariant
	MUNICIPALITY	Name of municipality	N/A	Time-invariant
	AREA	Territorial area of municipality	Km2	Time-invariant
Motorways & Expressways	EXT_MTW	Length of the motorway network	Meters (m)	1971-2020
	DEN_MTW	Density of the motorway network (EXT_MTW/AREA)	m/Km2	1971-2020
	EXT_MEXP	Length of the main expressways (IP)	Meters (m)	1971-2020
	DEN_MEXP	Density of the main expressways (IP) (EXT_MEXP/AREA)	m/Km2	1971-2020
	EXT_SEXP	Length of the secondary expressways (IC)	Meters (m)	1971-2020
	DEN_SEXP	Density of the secondary expressways (IC) (EXT_SEXP/AREA)	m/Km2	1971-2020
	MTW_AR	Number of motorway access ramps	Number (n)	1971-2020
	DEN_MTW_AR	Density of motorway access ramps (MTW_AR/AREA)	n/Km2	1971-2020
	TT_MTW_AR	Time travel to the nearest motorway access ramp (using 1981 population-weighted municipality centroids)	Minutes (min)	1971-2020
	RDIST_MTW_AR	Road distance to the nearest motorway access ramp (using 1981 population-weighted municipality centroids)	Meters (m)	1971-2020

Railways	NUM_ACTST	Number of active train stations	Number (n)	1971-2020
	TT_ACTST	Time travel to the nearest active train station (using 1981 population-weighted municipality centroids)	Minutes (min)	1971-2020
	RDIST_ACTST	Road distance to the nearest active train station (using 1981 population-weighted municipality centroids)	Meters (m)	1971-2020
Geographic variables	SDIST_PTCT	Straight line distance to Portuguese coast (using 1981 population-weighted municipality centroids)	Meters (m)	Time-invariant
	SDIST_PTBD	Straight line distance to Portuguese border (using 1981 population-weighted municipality centroids)	Meters (m)	Time-invariant
	CC81_ALT	Altitude of the 1981 population-weighted centroids	Meters (m)	Time-invariant
	ATE	Average terrain elevation	Meters (m)	Time-invariant
	STDTE	Standard deviation of terrain elevation (terrain ruggedness)	Meters (m)	Time-invariant
Market Potential	MP_PPA_TT	Market Potential - Potential Population Accessibility (travel time)	N/A	1971-2020
	MP_PPA_RDIST	Market Potential - Potential Population Accessibility (road-based distances)	N/A	1971-2020
	MP_NUTS3_PPA_TT	Market Potential - Potential Population Accessibility for the same NUTS3 municipalities (travel time)	N/A	1971-2020
	MP_NUTS3_PPA_RDIST	Market Potential - Potential Population Accessibility for the same NUTS3 municipalities (road-based distances)	N/A	1971-2020
	MP_PJA_TT	Market Potential - Potential Jobs Accessibility (travel time)	N/A	1991-2020
	MP_PJA_RDIST	Market Potential - Potential Jobs Accessibility (road-based distances)	N/A	1991-2020
	MP_NUTS3_PJA_TT	Market Potential - Potential Jobs Accessibility for the same NUTS3 municipalities (travel time)	N/A	1991-2020
	MP_NUTS3_PJA_RDIST	Market Potential - Potential Jobs Accessibility for the same NUTS3 municipalities (road-based distances)	N/A	1991-2020

APPENDIX B

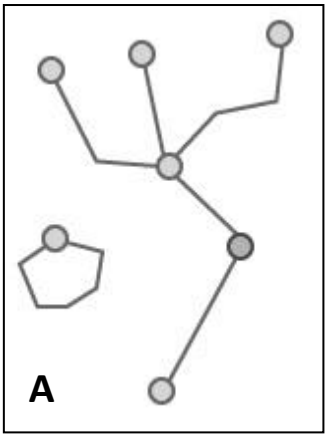
Topological network analysis

The topological network analysis was implemented using *ArcGIS* procedures and considered the following three rule: A) *Must not have pseudo nodes*; B) *Must not have dangles; C) Must Not overlap*.

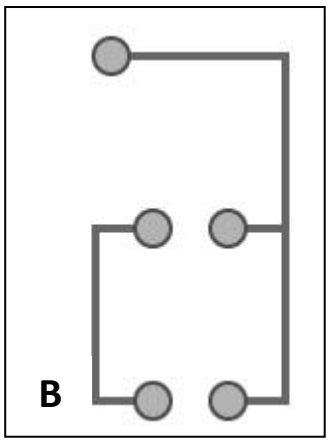
A. Must not have pseudo nodes. As mentioned in ESRI (2021), the objective is to avoid having intermediate nodes on a line. A line must connect to at least two other lines at each endpoint. This rule is useful to clean up data with inappropriately subdivided lines that can lead to so-called pseudo-nodes that should be deleted from the road network.

B. Must not have dangles. As referred in ESRI (2021), the objective is to avoid having breaks along the line's connections. A line feature must touch lines from the same feature class at both endpoints. So, when an endpoint is not connected to another line, due to an overshoot (line crosses too far over another line), or an undershoot (line is not long enough to meet the other line) we face a dangle error and it should be rectified.

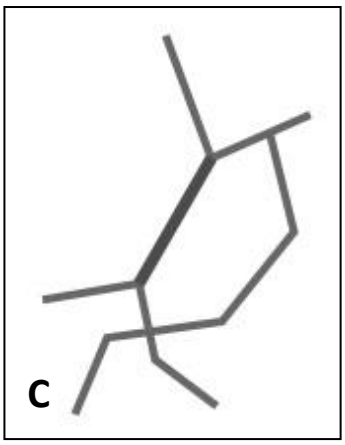
C. Must not overlap. As mentioned in ESRI (2021), this rule is used to avoid having duplicated line segments, which means that there should be no overlapping of line segments.



The darker point represents a pseudo node between the two blue endpoints of the segment.



The points show examples of dangles: endpoints with no connection to other line segments.



The darker line segment overlaps with the grey one, creating a duplication of segments.

Note: Pictures sourced from ESRI (2021).

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Existen Oportunidades de Fortalecer las Relaciones Comerciales y de Innovación de Galicia con Angola? Como Gestionarlas?

Are There Opportunities to Strengthen Galicia's Trade and Innovation Relations with Angola? How to Manage Them?

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Resumen

La publicación de la Ley Paz Andrade impulsa la relación económica con la Comunidad de Países de Lengua Portuguesa. Además, la Ley de Acción Exterior de Galicia marca un punto de inflexión en las relaciones económicas internacionales de la autonomía. En este contexto, es conveniente que Galicia configure y desarrolle una nueva estrategia en cuanto a las relaciones comerciales y de innovación con este grupo de países. En la presente investigación se analiza el estado actual de estas relaciones comerciales poniendo el foco en Angola. Se pretende dilucidar la conveniencia o no de la expansión de la economía gallega en este país, identificando para ello los aspectos estratégicos clave. El análisis propuesto (a través del estudio de datos procedentes de diversas fuentes oficiales, institucionales, etc.) pretende identificar oportunidades de mejora de la acción de las empresas gallegas en este país. Los resultados muestran que las expectativas podrían convertir a Angola en un interesante socio futuro.

Keywords: Política económica exterior, economía internacional, comercio internacional, innovación en comercialización, Ley Paz Andrade, Angola

JEL Codes: F02, F42, P45

Abstract

The publication of the Paz Andrade Law should boost Galician economic relations with the Community of Portuguese-speaking countries. In addition, the Galician External Action Act marks a turning point in the Autonomous Community´s internationalization. In this context, it is appropriate for Galicia to configure and develop a new strategy in terms of trade and innovation relations with this group of countries. This research analyses the current state of these trade relations, focusing on Angola. The aim is to elucidate whether the expansion of the Galician economy in this country is advisable, identifying the key strategic aspects. The proposed analysis (through the study of data from various official and institutional sources, etc.) aims to identify opportunities for improving the actions of Galician companies in this country. The results show that the expectations for Angola could make it an interesting future partner.

Keywords: External Policy, international economy, international trade, commerce innovation, Paz Andrade Law, Angola

JEL Codes: F02, F42, P45

1- INTRODUCCIÓN

Este artículo pretende contribuir desde el espectro de las relaciones económicas y comerciales y de innovación internacionales al análisis de las oportunidades de expansión económica exterior de Galicia, centrándose en la conexión con Angola, país miembro de la Comunidad de Países de Lengua Portuguesa (CPLP).

La Ley Paz Andrade (Xunta de Galicia, 2014) ha reconocido que la lengua gallega otorga a los ciudadanos gallegos una valiosa ventaja competitiva en muchos ámbitos, especialmente culturales, pero también económicos. Con el fin de mejorar el desarrollo social, económico y cultural gallego, las autoridades deben promover todas las medidas posibles para aprovechar al máximo esta ventaja histórica. En concreto, el artículo 3 de esta ley establece que "se promoverán las relaciones con los países de lengua portuguesa a todos los niveles, lo que constituye un objetivo estratégico de la Xunta de Galicia, incluyendo la participación de las instituciones en foros lusófonos de carácter económico".

Por otra parte, la aprobación de la Ley de Acción Exterior y Cooperación al Desarrollo de Galicia el pasado 23 de febrero de 2021 en el Parlamento abre una nueva etapa para la acción exterior de Galicia (IGADI, 2021). El nacimiento de esta ley ha impulsado la necesidad de construir políticas públicas de acción exterior con intencionalidad estratégica para el modelo de desarrollo gallego. El apartado l) del artículo 4 de esta ley establece como objetivo estratégico "Internacionalizar la economía y la sociedad gallegas, con una apuesta decidida por el conocimiento, la investigación y la creación como elementos singulares de la marca país", siendo estos aspectos culturales nexo con la comunidad lusófona, tal y como recoge el posterior artículo 16 de la misma ley. Esta norma también incide en la necesidad de internacionalización de la I+D+i gallega (art. 67) y en la participación exterior de las empresas de economía social (art. 81).

En adición, gracias a la colaboración gallega, la Conferencia de Jefes de Estado y de Gobierno de la Comunidad de Países de Lengua Portuguesa (CPLP) ha aprobado la adhesión de España como Estado Observador Asociado en la Cumbre de la organización celebrada en Luanda, en el año en que la CPLP celebra su 25 aniversario (Moncloa, 2021). A este respecto, es necesario recordar que Galicia no cuenta en su marco estatutario con ninguna mención a posibles acciones internacionales propias. A pesar de esta restricción, Galicia ha desarrollado regularmente acciones en el ámbito internacional, participando directa o indirectamente en política exterior, dependiendo del contexto. En este sentido la reciente publicación de la Ley de Acción Exterior de Galicia, tras la aprobación en 2014 de la Ley Paz Andrade, suponen un punto de inflexión en las relaciones económicas con los países lusófonos.

Con el fin de conocer en profundidad las relaciones económicas de Galicia con Angola y detectar oportunidades de expansión en el exterior, este artículo analiza la situación del comercio exterior y la innovación en Galicia con este país. Para ello, el artículo se estructura de la siguiente manera: en el segundo apartado se analiza la importancia de elegir un socio comercial adecuado, así como la importancia de la internacionalización de las innovaciones; en el tercer apartado, se incluye la descripción metodológica y las fuentes de datos; en el cuarto apartado, se describe la situación del comercio exterior y de la innovación empresarial en Galicia, así como la estructura económica de Angola; en el quinto apartado se analizan las relaciones económicas de Galicia con Angola; finalmente, el sexto apartado recoge las conclusiones derivadas de este estudio.

2- REVISIÓN DE LA LITERATURA

2.1. La importancia de la elección de los socios comerciales por parte de las regiones/países

Los acuerdos comerciales y de cooperación han proliferado durante las últimas décadas, con diferentes enfoques, en el contexto internacional. En ese contexto diverso, esta investigación pretende estudiar la situación comercial de Galicia con respecto a los países de la CPLP, y Angola en concreto, para discernir si son un socio económico interesante y cuál debería ser la mejor estrategia comercial y las políticas a seguir.

El modelo de Uppsala se considera una herramienta estratégica utilizada en el proceso de internacionalización que atraviesan las organizaciones, es decir, el camino que sigue una empresa a la hora de expansión hacia nuevos mercados. En esta expansión, la proximidad psico-geográfica ejerce como potenciador de la competitividad. Por otra parte, la creación y desviación de comercio favorecen los procesos de integración económica y monetaria (en detrimento de los países que quedan fuera).

Para algunos autores (Cortés & Ramón, 2001; Vélez-Ocampo & González-Pérez, 2022; Song & Lee, 2020), el éxito de la internacionalización pasa por un enfoque directivo que ajuste las decisiones estratégicas a las condiciones del entorno. Para Zevallos (2020) existiría una multicausalidad del éxito, enfocándose en aspectos como el tamaño de la empresa, la experiencia exportadora, el nivel de asociación de las empresas y la capacitación de los recursos humanos. Por su parte, Voudouris, Lioukas, Makridakis, & Spanos (2000) concretan el éxito de la internacionalización empresarial en cuatro factores: (a) especialización intensa en segmentos de mercado estrechamente definidos, (b) una cultura innovadora, (c) la adaptación a las nuevas tecnologías, y (d) un liderazgo fuerte y un clima organizativo saludable. No obstante, algunos autores (Singer, 1976; Balassa, 1993) mostraron históricamente opiniones pesimistas sobre la transferencia comercial a los países menos desarrollados debido a la falta de transferencia de precios entre economías ricas y pobres (Balassa & Word Bank, 1981).

Los estudios recientes se han centrado en dos tipos de factores cruciales para la elección de los socios comerciales: los socioeconómicos y los sociopsicológicos. El primer grupo incluye aspectos como el nivel educativo (Chiang, Liu & Wen, 2013), el tamaño de la empresa o la edad de la población (Zeuli & Betancor, 2005; Berlin 2006). El segundo grupo se centra en variables como la compatibilidad cultural y la confianza (Chen, Liu, & Hsieh, 2009; Levinson & Asahi, 1995; Reve & Stern, 1986), la actitud o el compromiso (James y Sykuta, 2006; Österberg & Nilsson, 2009; Nilsson, Kihlén y Norell, 2009). De hecho, según Enander, Melin & Nilson (2010), las relaciones sociales son significativas, ya que la elección del comprador es importante para los productores -económica, social y psicológicamente-. No es de extrañar así que Rousseau, Sitkin, Burt & Camerer (1998:395) afirmasen que "la confianza es un estado psicológico que comprende las intenciones de aceptar la vulnerabilidad basada en expectativas positivas sobre las intenciones o el comportamiento del otro".

Otros estudios recientes se han centrado en la importancia de los aspectos sociopolíticos. Así, mientras para Yasushi (2013) es relevante el propio crecimiento económico, para otros autores (Kali, Méndez & Reyes, 2007; Sarmiento, 2014) sería de vital importancia el crecimiento económico de los países socios. Pero el comportamiento empresarial para la elección de socios no sería único, sino que podría depender de factores como el tamaño de las empresas (Hadjikhani & Ghauri, 2001), razón por la que otros trabajos (García-Cabrera & García Soto, 2016; Kubíčková, Votoupalová & Toulová, 2014; Ke & Wei, 2007) se han centrado en estudiar las pequeñas y medianas empresas. Así, para los últimos autores los factores sociopolíticos afectarían en mayor medida que otros a la decisión de la empresa local de compartir o no relaciones con un socio determinado.

Por último, en referencia específica a las relaciones comerciales entre territorios de la CPLP, Roder & da Silva-Rego (2018) han realizado un estudio cuyos resultados muestran un aumento de las transacciones comerciales entre los Estados miembros. Al igual que el estudio de Sande (s.f.) para el caso de Galicia con estos países. Sin embargo, Fonseca, Mendonça & Passos (2010) discutían hace una década una consistencia en la sustitución entre la inversión directa en el exterior y la actividad comercial, detectando un efecto negativo en la balanza comercial de la mayoría de los países de la CPLP, exceptuando precisamente Angola y España. Pero el factor cultural continúa a ser determinante, por delante de otros factores de desarrollo como el estado o las instituciones sociales (Savelyev, Kutyashova, Savchenko, Koretsky & Polyakov, 2021). De hecho, algunos autores (Peng, 2006; Lee, Peng y Barney, 2007) defienden la necesidad de crear condiciones más sólidas a nivel institucional para crear un entorno favorable a la actividad empresarial y reducir las incertidumbres. Por este motivo, la CPLP acordó desarrollar mecanismos para hacer frente al mercado globalizado, declarando el compromiso de erradicar la pobreza y promover el desarrollo sostenible (CPLP, 2010), e incluyendo en 2012 dos objetivos fundamentales en la declaración de Luanda: (a) Centrarse en la cooperación económica y empresarial en clústeres y sectores de desarrollo y (b) Aplicar medidas que permitan superar las dificultades estructurales para el desarrollo del comercio y la inversión.

2.2. La importancia de la internacionalización de la innovación

De acuerdo con diferentes autores (Kafouros, Buckley, Sharp & Wang, 2008; Sommer & Bhandari, 2022; Leung & Sharma, 2021), la internacionalización aumenta la capacidad de las empresas para mejorar sus resultados mediante la innovación, incluso para las pequeñas empresas (Boermans & Roelfsema, 2016; Pastelakos, Theodoraki & Catanzaro, 2023). Sin embargo, las empresas no pueden beneficiarse de todos los efectos de la innovación si no cuentan con actividad internacional. En una línea similar, Filippetti, Frenz, & Ietto-Gillies (2011) defienden que la asociación entre internacionalización-innovación se sustenta en un círculo virtuoso (o vicioso): las empresas innovadoras tienen más éxito en la competencia internacional, y la exposición a contextos empresariales y de innovación alternativos conduce a la innovación. Por otra parte, Yu & Si (2012) han encontrado relación entre internacionalización a través de mercados bursátiles e innovación empresarial. Con un estudio centrado en el sector terciario Castaño, Méndez & Galindo (2016) corroboran que los empresarios del sector servicios que deciden innovar e internacionalizarse tienen expectativas de lograr un mayor crecimiento empresarial.

Pero esta relación entre internacionalización e innovación también se produciría en sentido contrario. Así, utilizando un panel de empresas manufactureras españolas, Cassiman & Golovko (2011) muestran que la fuerte asociación positiva encontrada en la literatura entre productividad de la empresa y exportaciones está relacionada con las anteriores decisiones de innovación de la empresa. Siendo así, parece adecuado que, tal y como sugieren algunos autores (Altomonte, Aquilante, Békés & Ottaviano2013; Martínez-Román, Gamero de Loreto-González & Tamayo, 2019), se produzca una coordinación e integración de las políticas de internacionalización e innovación "bajo un mismo techo", tanto a nivel nacional como de la UE, lo que supone un mayor papel coordinador para las instituciones.

3- METODOLOGÍA

En el presente apartado se abordan dos aspectos. Por una parte, se realiza una descripción de la metodología empleada. Por otra, se detallan las fuentes de información de las que se han obtenido las informaciones clave para la presente investigación.

A nivel de análisis y metodológico, abordar un trabajo como el presente ha requerido de un esfuerzo de búsqueda de información y de análisis de datos de diferente tipo. Por una parte, se han empleado datos de carácter macroeconómico que permiten contextualizar la realidad económica de los territorios analizados y, por otra, datos con información sectorial que permiten conocer la realidad a este nivel. Para el análisis de datos se ha recurrido fundamentalmente a la estadística descriptiva. Este análisis estadístico se ha combinado a su vez con informaciones cualitativas obtenidas de los principales agentes económicos involucrados. De esta manera, se ha procedido a aplicar métodos deductivos e inductivos, para lo que fue necesario recurrir a un riguroso tratamiento de los datos. Se ha empleado además la herramienta DAFO, que ha permitido efectuar un análisis de las características internas (debilidades y fortalezas) y externas (amenazas y oportunidades) de las relaciones entre los territorios analizados. El objetivo del análisis DAFO es determinar las ventajas competitivas de dichas relaciones.

La profusión de datos cuantitativos y cualitativos manejados en el presente trabajo (tabla 1) ha hecho necesario aplicar un gran esfuerzo de coordinación, estudio e interpretación de los resultados observados.

Tabla 1: Fuentes de datos y objetivos

Fuente	Tipo de datos	Objetivo
Organización Mundial del Comercio	Descriptivos	Marco comercial Mundial y CPLP
Ministerio de Industria, Comercio y Turismo	Datos analizados	Evolution of strategic indicators SP-And
Ministerio de Asuntos Exteriores	Datos analizados	Datos PIB Angola
Banco Nacional de Angola	Descriptivos	Datos económicos Angola
National Statistical Institute (INE)	Descriptivos	Evolución export-import España-Angola
Galician Statistical Institute (IGE)	Datos analizados	Evolución export-import Galicia-Angola
Oficinas Comerciales en el Exterior (ICEX)	Datos analizados	Evolución export-import España-Galicia-Angola
DatosMacro	Descriptivos	Evolución comercio internacional
Mundiestacom	Datos descriptivos	Evolución comercio internacional
Cámaras de Comercio	Datos descriptivos	Empresas exportación Galicia
Ardán, base datos (CZF, Vigo)	Datos descriptivos	Datos I+D+i Galicia

Fuente: Elaboración propia

4- LA SITUACIÓN ACTUAL DE LAS RELACIONES COMERCIALES Y DE LA INNOVACIÓN EMPRESARIAL EN GALICIA Y LA REALIDAD ECONÓMICA DE ANGOLA

4.1. Caracterización de las exportaciones gallegas: los países de la CPLP

De acuerdo con Sande (s.f.), mientras que la participación de Galicia en el PIB español se sitúa en torno al 5%, las exportaciones gallegas supusieron el 7,81% del total estatal, y las importaciones el 5,69%. La balanza comercial gallega es positiva entre 2000 y 2021, con un descenso significativo de los valores tras la crisis financiera y el provocado por la pandemia, con especial relevancia en la separación de valores entre exportaciones e importaciones a partir de 2008-2009 (figura 1). En cuanto a la evolución en los últimos años, y según datos del IGE, el principal destino de las exportaciones gallegas tiende a ser los países pertenecientes a la Zona euro, responsables de la absorción de alrededor del 60% de las exportaciones. Los cinco países de la UE que reciben de forma más estable los productos gallegos son Francia y Portugal (con porcentajes superiores a los dos tercios), e Italia, Reino Unido y Alemania (con valores superiores al 5%). También son importantes como mercados de destino de la producción industrial gallega las economías desarrolladas de la OCDE, pero también los países de la OPEP y Mercosur, con un valor próximo al 1,5% del total.

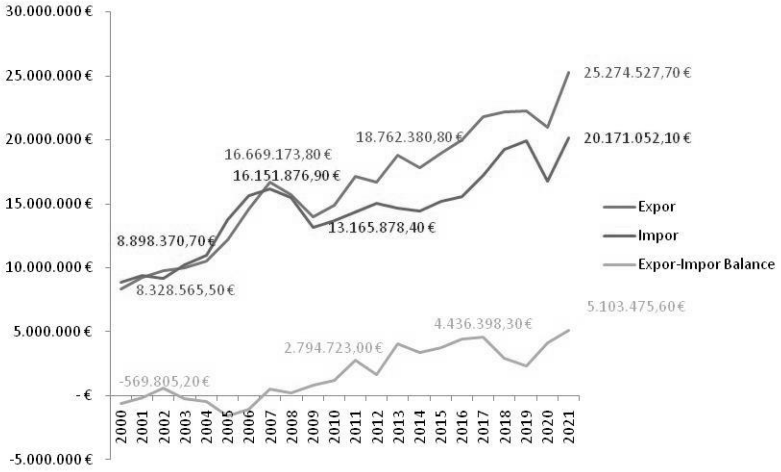
En la otra cara de la moneda, la que se refiere a las importaciones, el comportamiento repite parte del patrón exportador, ya que más de la mitad de las importaciones suelen proceder de la zona euro, siendo también importantes el resto de los países de la OCDE.

Francia y Portugal vuelven a ser los principales proveedores de bienes y servicios de la Comunidad Autónoma, con porcentajes que suelen superar los dos dígitos. Les siguen Italia, Alemania, China, México y EE. UU. (todos ellos con cifras entre el 3-5%). En el caso de los países miembros de la OPEP, éstos llegan a representar en torno al 8% de la producción adquirida, y alrededor del 3% en el caso de los países de Mercosur. Sin embargo, la mayor parte de las exportaciones e importaciones gallegas recaen en destinos europeos (con un volumen creciente), el resto de los territorios siguen teniendo una participación mucho menor. Aunque las importaciones de otros continentes aumentan, no hay un avance tan claro en el caso de las exportaciones (Sande, s.f.).

A pesar de que el mercado más importante para Galicia sigue siendo el francés (2.529 M€), países como Portugal, Italia y Países Bajos han incrementado sus compras (143%) en la Comunidad Autónoma hasta alcanzar los 1.066 M€, por delante de potencias como Alemania (783 M€, un 32% más). Por el lado de las importaciones, destaca el aumento del gas natural licuado (GNL) procedente de EE.UU., que está abasteciendo al continente europeo tras el estallido de la guerra en Ucrania. Este aumento elevó las compras totales a este país a 1.128 millones de euros (+92%). Sin embargo, la balanza comercial siguió siendo claramente positiva (como puede verse en la figura 1). Los resultados comerciales gallegos contrastan con el agujero de 31.963 M€ en las cuentas del Estado, en

el que el déficit se ha multiplicado por seis en comparación con el primer semestre de 2021, debido principalmente a la subida de los precios de la energía.

Figura 1: Evolución de las Exportaciones e Importaciones gallegas, 2000-2021 (miles de euros)



Fuente: Elaboración propia basada en datos del IGE

Las exportaciones gallegas se concentraron a mediados de la década pasada en torno a la industria del transporte (27,3%) y la industria téxtil (21,6%). El sector de fabricación de automóviles se comportó con cierta estabilidad y exportó en 2015 alrededor de 5.140 M€ -entre turismo (3.109 M€), vehículos de transporte (1.367 M€) y accesorios para vehículos (628 M€)-. Por su parte, la industria téxtil ha crecido en los últimos años y ha exportado aproximadamente 4.073 millones de euros, siendo los principales productos la ropa de mujer (1.434 millones de euros) y de hombre (970 millones de euros), seguidos de batas y similares (459 millones de euros), camisetas (330 millones de euros) y trajes y vestidos de mujer (193 millones de euros). En tercer lugar, se sitúa el sector agroalimentario, cuyas exportaciones alcanzaron los 2.571 millones de euros en 2015, el 13,7% del total de las exportaciones gallegas (Sande, 2019). Por otro lado, la mayor parte de las importaciones se concentran en los mismos sectores que las exportaciones. Las compras más relevantes se produjeron en el sector de la automoción (4.071 M€ y el 26,9% del total), en el agroalimentario (2.821 M€ y el 18,7%), en los combustibles (2.283 M€ y el 15,1%) y en la industria textil (1.468 M€ y el 9,7%).

En este artículo también se analizan las cifras de exportación según su clasificación TARIC (tabla 2) para comprobar qué ha ocurrido con los principales productos exportados en el periodo 2016-2021. El peso de las exportaciones de material de transporte alcanzó un tercio del total (30,12%), mientras que el sector téxtil acaparó más de una quinta parte de las exportaciones gallegas (22,56%).

Por debajo del 10% se situaron otras actividades como la exportación de animales vivos (8,31%), metales comunes (7,38%) y productos industriales alimentarios (4,31%). En relación con las importaciones (tabla 3), destacaron las de material de transporte (27,22% del total), productos minerales (14,21%) y animales vivos (11,83%). La compra de metales comunes (9,67%) y materiales téxtiles (9,66%) tuvieron un peso ligeramente inferior. En cuanto a la evolución en el periodo, lo que se observa es el importante aumento del valor de las exportaciones en el caso de todo tipo de productos, especialmente en el sector téxtil. Lo mismo ocurre en el caso de las importaciones, que aumentan para las principales actividades en términos de volumen.

El crecimiento anual de las exportaciones gallegas ha aumentado un 27,1% en el último año debido a la recuperación económica tras la pandemia. Este crecimiento sitúa a Galicia por delante de la media española (24,8%). En concreto, las empresas gallegas consiguieron facturar al exterior 14.406 M€ entre enero y junio, un hito histórico. Este incremento se debe en gran medida a las exportaciones del sector téxtil, que aumentó sus ventas al exterior un 60,6% respecto al año anterior. No obstante, otros sectores también mejoraron sus resultados en los mercados exteriores, como la maquinaria y aparatos mecánicos (+40,2%), la metalurgia (+30,4%) y el pescado y marisco (+29,2%). Por el contrario, un sector clave para la economía gallega como el del automóvil no pudo seguir esta senda, ya que sus ventas al exterior cayeron un 13,5%, debido en gran parte a la crisis de chips y semiconductores que está provocando problemas de abastecimiento en el sector. Con estas

cifras, Galicia recorta distancias con las principales comunidades exportadoras del Estado (Cataluña, Madrid, Andalucía, Comunidad Valenciana y País Vasco).

Tabla 2: Exportaciones gallegas por TARIC, 2016-2021 (M€)

	2016	2017	2018	2019	2020	2021	Peso (%)	Incremento (%)
I. Animales vivos y productos de origen animal	1.740,88	1.900,24	1.897,08	1.926,62	1.750,83	2.102,51	8,32	20,77
II. Productos del reino vegetal	206,84	180,11	197,85	215,49	219,77	236,14	0,93	14,17
III. Grasas/ácidos animales/vegetales; grasas preparadas; ceras animales o vegetales	52,09	64,93	61,04	65,36	76,71	980,29	3,88	1781,92
IV. Productos alimenticios industriales; bebidas, licores, vinagre; tabaco	761,82	865,2	909,87	929,98	1.096,34	1.090,30	4,31	43,12
V. Productos minerales	958,64	1.600,77	1.980,18	1.591,47	904,85	1.503,19	5,95	56,80
VI. Productos químicos y otros productos industriales	758,17	741,37	793,57	837,69	757,18	927,44	3,67	22,33
VII. Plásticos; Caucho	251,86	291,61	285,08	307,18	332,96	379,52	1,50	50,69
VIII. Pieles, cuero, manufacturas	232,08	237,78	213	220,37	149,5	179,28	0,71	-22,75
IX. Madera y productos de madera, Carbón; Corcho	420,63	424,57	473,02	482,42	454,38	602,06	2,38	43,13
X. Madera y otras pastas; Papel y productos de papel	265,93	309,83	360,27	323,27	254,6	329,1	1,30	23,75
XI. Téxtiles y manufacturas	5.281,61	5.863,73	5.839,67	5.834,36	4.377,33	5.702,31	22,56	7,97
XII. Calzado; sombreado, cortinajes y otros	419,91	459,01	463,36	461,3	347,62	377,16	1,49	-10,18
XIII. Piedra y otras manufacturas; vidrio	380,76	389,17	418,61	404,54	404,36	448,56	1,77	17,81
XIV. Perlas, piedras preciosas y semipreciosas; monedas	25,59	22,75	22,54	286,78	19,031	26,96	0,11	5,35
XV. Metales comunes y manufacturas	1.123,32	1.475,88	1.537,61	1.359,35	1.222,98	1.867,76	7,39	66,27
XVI. Maquinaria, material eléctrico, aparatos de reproducción de sonido y vídeo, y otros	1.029,47	1.032,72	1.441,49	1.372,96	997,23	1.071,75	4,24	4,11
XVII. Material de transporte	5.585,99	5.379,54	5.390,43	5.309,66	7.087,17	7.614,38	30,13	36,31
XVIII. Instrumentos ópticos y fototácticos; instrumentos médico-quirúrgicos, relojería	40,88	42,48	38,95	39,6	42,09	40,37	0,16	-1,25
XIX. Armas, municiones y componentes	0,05	0,09	0,2	0,21	0,41	0,18	0,00	260,00
XX. Bienes y productos diversos	261,38	296,76	278	290,8	193,01	304,48	1,20	16,49
XXI. Objetos de arte y antigüedades	0,15	0,09	0,1	0,39	0,15	0,35	0,00	133,33
No clasificados	186,45	222,99	260,96	260,18	267,73	372,58	1,47	99,83
TOTAL	**19.984,51**	**21.801,61**	**22.862,87**	**22.261,98**	**20.956,32**	**25.274,52**	**100**	**26,47%**

Fuente: Elaboración propia basada en datos del IGE

Tabla 3: Importaciones gallegas por TARIC, 2016-2021 (M€)

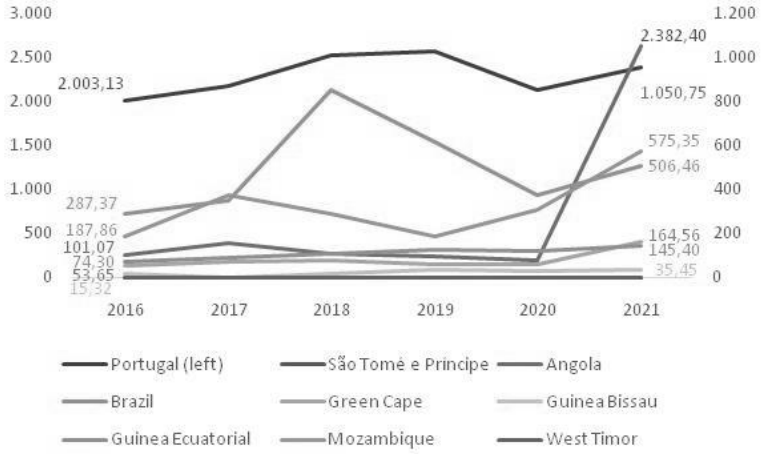
	2016	2017	2018	2019	2020	2021	Peso (%)	Incremento (%)
I. Animales vivos y productos de origen animal	2.094,62	2.227,16	2.357,90	2.225,89	2.066,83	2.386,56	11,83	13,94
II. Productos del reino vegetal	403,38	357,87	317,4	367,9	326,65	376,12	1,86	-6,76
III. Grasas/ácidos animales/vegetales; grasas preparadas; ceras animales o vegetales	216,07	281,41	275,32	208,88	259,85	314,89	1,56	45,74
IV. Productos alimenticios industriales; bebidas, licores, vinagre; tabaco	565,47	738,04	798,04	830,25	853,92	938,76	4,65	66,01
V. Productos minerales	1.874,55	2.814,84	3.551,73	3.396,92	1.625,74	2.868,31	14,22	53,01
VI. Productos químicos y otros productos industriales	361,17	426,73	519,21	572,43	488,09	599,38	2,97	65,96
VII. Plásticos; Caucho	383,35	464,63	507,68	453,54	415,14	514,8	2,55	34,29
VIII. Pieles, cuero, manufacturas	73,88	73,11	77,66	120,41	73,54	90,541	0,45	22,55
IX. Madera y productos de madera, Carbón; Corcho	101,95	109,598	127,69	121,39	110,4	159,9	0,79	56,84
X. Madera y otras pastas; Papel y productos de papel	169,22	167,84	205,83	222,74	214,36	228,35	1,13	34,94
XI. Téxtiles y manufacturas	2.148,91	1.814,83	1.776,25	2.039,52	1.707,16	1.938,51	9,61	-9,79
XII. Calzado; sombreado, cortinajes y otros	100,28	92,34	105,54	123,74	98,19	109,59	0,54	9,28
XIII. Piedra y otras manufacturas; vidrio	63,69	63,5	70,38	82,49	71,23	90,8	0,45	42,57
XIV. Perlas, piedras preciosas y semipreciosas; monedas	19,39	18,73	16,06	20,73	13,59	19,68	0,10	1,50
XV. Metales comunes y manufacturas	1.210,59	1.351,32	1.645,58	1.664,95	1.548,23	1.950,32	9,67	61,10
XVI. Maquinaria, material eléctrico, aparatos de reproducción de sonido y vídeo, y otros	861,06	950,87	1.162,54	1.417,81	1.457,15	1.669,26	8,28	93,86
XVII. Material de transporte	4.619,05	5.007,77	5.449,16	5.770,22	5.083,90	5.491,13	27,22	18,88
XVIII. Instrumentos ópticos y fototácticos; instrumentos médico-quirúrgicos, relojería	74,51	74,85	75,68	89,22	139,98	148,16	0,73	98,85
XIX. Armas, municiones y componentes	0,86	0,64	34,51	5,76	0,32	0,87	0,00	1,16
XX. Bienes y productos diversos	201,42	200,94	184,62	209,56	232,44	258,75	1,28	28,46
XXI. Objetos de arte y antigüedades	0,77	0,88	0,23	0,58	2,93	0,97	0,00	25,97
No clasificados	3,81	5,15	104,568	11,95	11,78	15,29	0,08	301,31
TOTAL	**15.548,11**	**17.243,13**	**19.238,51**	**19.956,99**	**16.801,49**	**20.171,05**	**100**	**29,73**

Fuente: Elaboración propia basada en datos del IGE

Por otra parte, el área de influencia económica de la CPLP abarca una población de 267 millones de personas en 10.742.000 km2. Entre los países de la CPLP destacan las relaciones comerciales de Galicia con Portugal y Brasil, pero especialmente con Portugal. Por este motivo, en este apartado se analizarán en primer lugar las relaciones comerciales con el país luso y, a continuación, con otros países de la CPLP. La hipótesis es que todavía existe un gran potencial por explotar en cuanto a las relaciones con otros miembros de la comunidad lusófona. Se ha efectuado un análisis comparativo de las exportaciones gallegas (figura 2) y de la evolución de la cuota de mercado de las exportaciones gallegas a los países de habla portuguesa en los últimos años (figura 3). Destaca la importancia

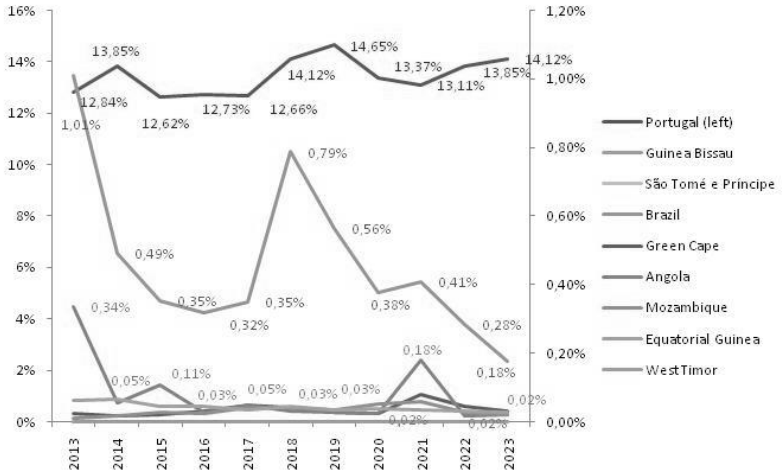
actual de Portugal (13,85% en 2022). Le sigue Brasil (0,28%), seguido de Cabo Verde (0,05%), Mozambique y Guinea Ecuatorial (0,03%), Angola (0,02%) y el resto de los países, con valores casi irrelevantes. En términos de evolución, cabe destacar que Portugal llegó a representar más del 18% de la cuota de exportaciones al inicio del periodo analizado. El resto de los países muestran en general una evolución negativa respecto a los años anteriores a la Gran Recesión.

Figura 2: Evolución del valor de las exportaciones medias a países de la CPLP, 2016-2021 (miles de euros)



Fuente: Elaboración propia basada en datos del IGE

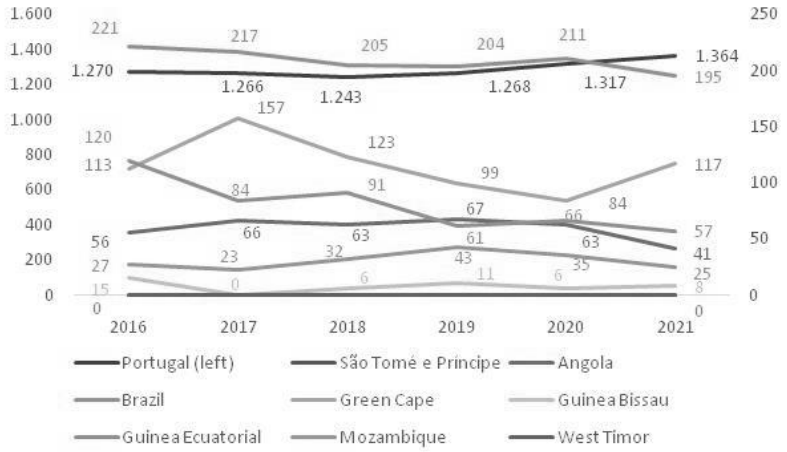
Figura 3: Evolución de la cuota de exportaciones de Galicia a los países de la CPLP, 2000-2022 (%)



Fuente: Elaboración propia a partir de datos recabados del Ministerio de Industria, Comercio y Turismo de España

Cabe señalar que la pérdida de cuota de mercado podría deberse a una mayor diversificación. Esta se ha situado los tres últimos años entre el 13%-14%, mientras que venía previamente oscilando de manera habitual entre el 15%-20%. En términos absolutos, las exportaciones gallegas a los países de la CPLP se han más que triplicado en los últimos veinte años, impulsadas principalmente por el fortalecimiento de las relaciones con Portugal, y el incremento de empresas implicadas en estas relaciones (figura 4), a diferencia del resto de países.

Figura 4: Empresas gallegas exportando a países de la CPLP, 2016-2021 (número de empresas)



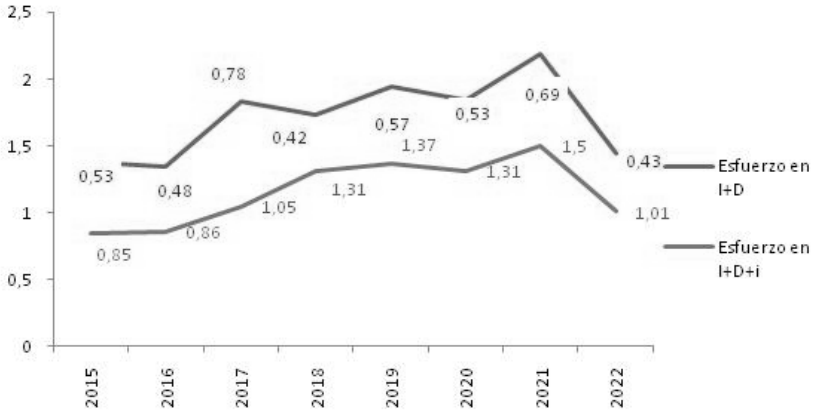
Fuente: Elaboración propia a partir de datos camerales

4.2. La situación de la innovación empresarial en Galicia

Uno de los aspectos clave del futuro de las relaciones comerciales pasa por la internacionalización de la innovación de los territorios. En esa dirección, en el presente trabajo se analiza la situación sectorial de la innovación empresarial en Galicia.

De acuerdo con los datos de la figura 5, el mayor nivel de inversión empresarial en I+D de los últimos años en relación con su facturación se produjo en 2017 (0,78%), la mitad de la media de la UE-27 (1,67%). La media en Estados Unidos ronda el 2,05%, en Japón el 2,60%, y en países como Suecia o Finlandia incluso superan el 3%. La brecha es aún importante entre la región gallega y los líderes europeos, a lo que habría que añadir las necesidades de completar la vertebración del sistema gallego de innovación (Sande, 2020), y de elaboración de políticas de innovación empresarial más ajustadas a objetivos específicos (Sande, 2022a; 2022b; Sande & Vence, 2021; 2019; Sande & Sande, 2023).

Figura 5: Esfuerzo en I+D e I+D+i de las empresas gallegas, 2015-2022 (%)



Fuente: Elaboración propia a partir de datos del Informe Ardán (2023)

Empleando una muestra de 251 empresas, Ardán (2023) toma los datos de los últimos ejercicios 2021-2022 para estudiar el esfuerzo en I+D de las empresas gallegas. Como se aprecia en la siguiente tabla 4, el esfuerzo en I+D+i de esas empresas pasó de 1,40% (2021) a 1,08% (2022). A este respecto, cabe señalar que la inversión en I+D había aumentado ligeramente en ese mismo período (+0,03%, desde un 0,46% a un 0,49%), lo que implicaría un descenso de las inversiones en innovación.

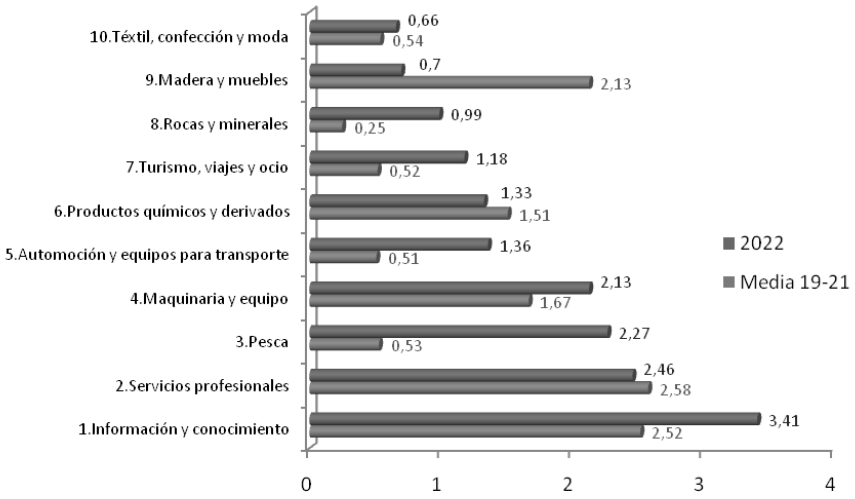
Tabla 4: Esfuerzo I+D empresas gallegas, 2021-2022 (€)

	2021	2022
I+D+i	45.076.622,24	38.268.032,02
Innovación	30.394.488,16	20.807.867,58
Cifra negocio	3.219.428.154,76	3.528.511.655,07

Fuente: Datos de Ardán (2023)

A continuación, se ha analizado sectorialmente el esfuerzo inversor de las empresas gallegas en I+D+i, diferenciando las inversiones en I+D de las inversiones en innovación ("i"). Una conclusión destacable de la observación de los datos de I+D es la estabilidad en los primeros puestos del ranking para los sistemas productivos de Información y Conocimiento, y Servicios Profesionales. Son actividades estas intensivas en conocimiento y con capacidad para generar empleos altamente cualificados, además de nuevos productos y procesos y efectos *spillover*. Por otro lado, cabe resaltar la presencia intermitente del sistema productivo de la Pesca, por ser esta una actividad enraizada en la estructura productiva gallega, y por ser también una actividad relevante en países como Angola. A este respecto, el ecosistema productivo gallego está compuesto no sólo por armadoras, sino también por empresas transformadoras, lo que permite la existencia de espacios para potenciar la actividad de I+D en el sector. Además, un refuerzo en este sentido permitiría continuar construyendo fortalezas en el mar-industria autonómico, a través de aspectos como el uso de nuevos materiales, el diseño y gestión de los barcos, o los sistemas de comunicación, posicionamiento y seguridad de los barcos, además de mejoras en el desarrollo de tecnologías ópticas para reconocimiento del pescado, pesaje de capturas, o de mejoras a nivel logístico y de automatización de procesos industriales, entre otros. En lo que concierne al resto de sectores, tan solo cabe mencionar que muestran un patrón estable, destacando las inversiones en la Automoción y equipos para transporte; Salud y asistencia social; Textil, confección y moda; o Maquinaria y equipo (figura 6).

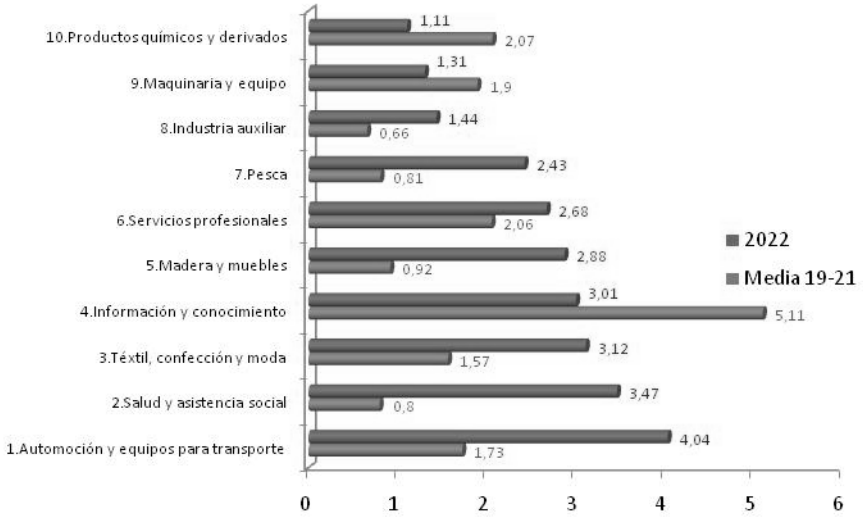
Figura 6: Sistemas productivos por esfuerzo en I+D en Galicia, 2019-2022 (%)



Fuente: Elaboración propia a partir de datos del Informe Ardán (2023)

Respecto del esfuerzo en innovación, destaca el sector de los transportes y la automoción, seguido por el sector de la salud en segundo lugar, y el téxtil en tercero. Las TIC ocuparían el cuarto lugar, mientras que sectores estratégicos gallegos como el de la madera y muebles, el de la pesca, la producción de maquinaria y la de productos químicos contarían también con inversiones destacadas en la actualidad (figura 7).

Figura 7: Sistemas productivos por esfuerzo en innovación en Galicia, 2019-2022 (%)



Fuente: Elaboración propia a partir de datos del Informe Ardán (2023)

4.3. La realidad económica de Angola

4.3.1. La estructura económica de Angola

Angola es uno de los países africanos con menos diversificación y más acoplado a la evolución del precio del crudo. En los últimos 15 años, el único producto nuevo que se ha añadido a la "cesta de exportaciones" es el gas natural (Marín, 2021). La ausencia de incentivos hacia otros sectores es un aspecto clave que dificulta las reformas económicas. El sector industrial (46% del total del PIB), el peso creciente del sector servicios (45,5%) y la importancia de la agricultura (8,5%), caracterizan la economía del país. El sector público es el principal agente económico. El coste de vida es muy elevado, especialmente en la capital. A pesar de tener una renta per capita fluctuante en el tiempo y que ha llegado a superar los 6.000 USD, la distribución de la renta es absolutamente dispar, con una minoría con rentas elevadísimas y una mayoría que vive en el umbral de la pobreza. La clase media es prácticamente inexistente (tabla 5). Pero Angola está abriendo sus mercados desde su situación de oligopolio, en sectores como el de los productos básicos para el desarrollo industrial, el agrícola y el sector servicios (Oficina Económica y Comercial de España en Luanda, 2020).

Destaca en la estructura del PIB el aumento del peso que representaron entre 2018-2019 actividades como la agricultura, pesca y derivados, extracción de diamantes y producción de petróleo (del 29,72% al 36,96%). A pesar de esta evolución, su desempeño que se ha visto frenado con la pandemia del COVID. Pero Angola –quinta economía africana en términos de PIB y segundo productor de petróleo en África Subsahariana–, experimentó un impulso económico positivo en 2022 que le permitió salir de una larga y profunda recesión de seis años (2016-2021). La recuperación económica, apoyada en el aumento de los precios del petróleo y los altos niveles de producción, ha impulsado el crecimiento económico y el entorno macro en general, además de ayudar al país a reducir su deuda pública al 56,5% del PIB (frente al 79,7% en 2021) (tabla 6).

Tabla 5: Principales descriptores e indicadores económicos de Angola

ELEMENTO	DESCRITIVO
INTERNACIONAL	
Moneda	Kwanza angoleño
Tasa de cambio	893,88 kwanza por US$ (01/09/2023)
Organizaciones internacionales	OMC, Unión Africana, Fondo Monetario Internacional
MACROECONOMÍA	
PIB (nominal)	110.043 millones € (2022)
Variación del PIB (2013-2022)	7%
PIB per capita (nominal)	3.189 € (2022)
PIB por sectores	Agricultura 8,5%, industria 46% comercio y servicios 45,5% (2021)
Inflación (IPC)	12,10% (julio 2023)
DESARROLLO	
Índice de Desarrollo Humano (IDH)	0,581 (medio) (148.º) (2019)2
Índice de Corrupción	33
TRABAJO	
Fuerza laboral	8 240 000 (2011)
Tasa de desempleo	15,8% (1º trimestre de 2021)
Principales industrias	Extracción de petróleo; diamantes, mineral de hierro, fosfato, feldespato, bauxita, uranio y oro; cemento; productos básicos de metal; procesado de pescado, procesado de alimentos, cerveza, tabaco, azúcar; téxtiles; reparación de barcos
COMERCIO	
Exportaciones	28.187,30 millones € (2021)
Principales productos exportados	Petróleo crudo, diamantes, derivados del petróleo, café, yute, pescado, madera, algodón
Principales destinos de exportación	China (61,17%), India (8,30%), EE.UU. (5,29%), E.A.U. (2,97%)
Importaciones	10.803,10 millones € (2021)
Principales productos importados	Máquinas y equipamientos, vehículos y piezas, fármacos, alimentos, téxtiles, equipamiento militar
Origen de las importaciones	China (20,16%), Asia (otros, 17,29%), Bélgica (5,67%), EE.UU. (4,74%), Singapur (4,72%), Sudáfrica (4,44%)
SECTOR PÚBLICO	
Gasto público (2021)	12.319,5 millones €
Gasto Educación (% Gto. Público) (2020)	1.209,2 millones € (10,38%)
Gasto Salud (% Gto. Público) (2017)	1.395,9 millones € (5,43%)
Gasto Defensa (% Gto. Público) (2021)	715,4 millones € (6,78%)
Deuda total (% PIB)	54.890 millones € (86,86%)

Fuente: Elaboración propia a partir de datos del FMI, Datos Macro, ICEX

Tabla 6: Comparativa de la estructura del PIB por actividad en Angola, 2010-2021

Productos	2010	2021	Tasa variación media anual
Sector primario: agricultura, ganadería y pesca	**6,1**	**8,5**	**0,13**
Sector industrial:	**52,4**	**46,0**	**-0,01**
Extracción de petróleo y gas natural	37,5	28,9	-0,02
Extracción de diamantes y otros	0,7	1,6	0,21
Construcción	9,0	9,6	0,10
Otros	5,2	5,9	0,10
Sector servicios:	**41,9**	**45,5**	**0,10**
Comercio	11,5	17,4	0,14
Transportes y almacenaje	2,7	1,8	-0,03
Correos y telecomunicaciones	1,8	2,6	0,13
Intermediación financiera y seguros	2,0	0,7	-0,06
Administración pública y defensa	10,6	9,9	-0,006
Servicios inmobiliarios	4,4	5,9	0,12
Otros servicios	8,5	5,6	-0,03

Fuente: Elaboración propia a partir de datos del Ministerio de Asuntos Exteriores (2023)

En cuanto a los orígenes de la inversión extranjera directa en el país (IED) destaca el primer lugar ocupado por EE.UU., seguido por Francia y China. Son varios los países europeos con presencia inversora en el país, una cuestión que estaría relacionada con la abundancia de proyectos ligados al sector petrolífero (tabla 7).

Tabla 7: Principal origen de la IED en Angola (millones dólares)

País	Inversión	País	Inversión
1º EEUU	425,9	7º Portugal	35,9
2º Francia	367,7	8º Argentina	0,8
3º China	245,2	9º Cuba	0,07
4º Italia	204,7	10º Malasia	0,03
5º Reino Unido	200,7	11º Otros	0,02
6º Noruega	122,9		

Fuente: Elaboración propia a partir de datos del Banco Nacional de Angola (2018)

4.3.2. Las relaciones comerciales de Angola

Las fuentes de información comercial en Angola continúan siendo parcialmente confusas. China es el primer socio comercial de Angola según las estadísticas angoleñas. No obstante, fuentes como Mundistacom no reflejan las exportaciones ni importaciones de China de algunos ejercicios. En las estadísticas del INE, China figura también como principal socio (tabla 8), mientras que Portugal sería el segundo país suministrador en 2017 (con una cuota del 12,5% en 2017). No obstante, en la base de datos Mundiestacom Portugal no aparecería entre los primeros países de importación, lo que es indicativo de las dificultades de obtención de datos certeros para Angola.

Tabla 8: Principales socios comerciales de Angola en 2018 (miles euros)

Clientes	Exportaciones	Cuota	Suministradores	Importaciones	Cuota
China	25.652.016,50	52%	China	2.234.927,77	20,1%
India	4.337.925,19	8,8%	EAU	1.003.917,88	9%
EEUU	2.768.924,98	5,6%	Sudáfrica	553.533,723	6,9%
EAU	1.569.493,44	3,2%	EEUU	543.961,717	5,6%

Fuente: Elaboración propia a partir del informe de la Oficina Económica y Comercial de España en Luanda (2021) y Mundistacom

El principal producto exportado por Angola al resto del mundo es el petróleo, que supone más del 90% del total de las exportaciones (tabla 9). En las últimas décadas, el único producto nuevo que se ha incorporado a la cesta de exportaciones angoleñas ha sido el gas natural que, junto con la tradicional exportación de diamantes, completan el total de las ventas al resto del mundo. Desde el

punto de vista de las compras de Angola al exterior, China suministra fundamentalmente máquinas, aparatos mecánicos y combustibles.

Tabla 9: Principales exportaciones e importaciones de Angola por capítulo arancelario, 2019 (%)

Exportaciones		Importaciones	
Producto	Cuota	**Producto**	Cuota
27-Combustibles	91,7%	84-Máquinas y aparatos mecánicos	18,3%
71-Piedra, Metales preciosos, joyería	4,06%	27-Combustibles	8,3%
89-Barcos y embarcaciones	1,13%	85-Aparatos y materiales eléctricos	5,6%
84-Máquinas y aparatos mecánicos	0,92%	02-Carne y despojos comestibles	5,53%

Fuente: Elaboración propia a partir del informe económico y comercial de Angola (ICEX, 2021) y Mundistacom

En cuanto al sector servicios, para el país el desarrollo de infraestructuras de transportes y turísticas se ha marcado como un gran reto de Gobierno por la oportunidad de ingresos, empleo y progreso social que conlleva el sector. A pesar de esto, el número de visitantes en Angola en 2019, último dato disponible, fue únicamente de 217.000 personas, si bien el potencial del sector sería mucho mayor mejorando aspectos como la seguridad y oferta para los visitantes.

5- ANÁLISIS DE LAS RELACIONES ECONÓMICAS DE GALICIA CON ANGOLA: DEBILIDADES, AMENAZAS, FORTALEZAS, OPORTUNIDADES

5.1. El marco gallego: las relaciones económicas bilaterales España-Angola

El principal producto exportado a España es igualmente el petróleo crudo y, así, la balanza comercial de España con Angola es históricamente deficitaria. España recibe aproximadamente el 2% del total de exportaciones del país de este producto, superando las compras estatales a las de Portugal o Francia. Luego es posible afirmar que España representa para Angola el principal socio comercial europeo, en lo que a exportaciones de este producto se refiere. En cuanto a las compras de Angola, España no tiene excesiva relevancia (ver tabla 10), siendo Portugal el socio comercial europeo de referencia.

Tabla 10: Evolución de las exportaciones españolas a Angola, principales capítulos arancelarios (miles euros, % s/ total)

CNAE	2017	2018	2019	2020	2021	2022
84 MÁQUINAS Y APARATOS MECÁNICOS	52.973,94 *(44,41%)*	5.437,34 *(13,38%)*	10.697,13 *(17,89%)*	9.704,57 *(18,72%)*	7.368,22 (12,82%)	14.780,45 *(19,20%)*
87 VEHÍCULOS AUTOMÓVILES; TRACTORES	3.701,97 *(3,10%)*	1.020,16 *(2,51%)*	1.871,28 *(3,13%)*	13.296,45 *(25,65%)*	943,93 *(1,64%)*	1.755,56 *(2,28%)*
85 APARATOS Y MATERIAL ELÉCTRICO	3.555,33 *(2,98%)*	1.414,16 *(3,48%)*	2.932,00 *(4,90%)*	5.271,68 *(10,17%)*	3.464,88 *(6,03%)*	10.611,98 *(13,79%)*
48 PAPEL, CARTÓN; SUS MANUFACTURAS	4.429,20 *(3,71%)*	1.989,12 *(4,90%)*	1.764,68 *(2,95%)*	2.718,81 *(5,24)*	4.990,42 *(8,68%)*	3.951,14 *(5,13%)*
39 MAT. PLÁSTICAS; SUS MANUFACTU.	12.840,99 *(10,77%)*	3.041,96 *(7,49%)*	3.324,83 *(5,56%)*	2.025,45 *(3,91%)*	1.135,55 *(1,98%)*	1.389,89 *(1,81%)*
21 PREPARAC. ALIMENTICIAS DIVERSAS	2.309,18 *(1,94%)*	1.855,39 *(4,57%)*	1.968,72 *(3,29%)*	1.275,18 *(2,46%)*	1.339,71 *(2,33%)*	891,94 *(1,16%)*
Total de Exportaciones	**119.275,71**	**40.630,68**	**59.783,21**	**51.846,50**	**57.467,15**	**76.975,61**

Fuente: Elaboración propia a partir de datos de del Ministerio de Industria, Comercio y Turismo de España, 2023

España tiene una presencia reducida de empresas en el país, apenas una veintena, según el registro del ICEX para el 2022. En años anteriores, sin embargo, la cifra de empresas españolas era casi del doble. En los años de mayor corrupción del gobierno de Dos Santos, algunas empresas españolas que estaban haciendo negocios en Angola aparecieron en los "Luanda leaks" y han sido, y están siendo, investigadas por posibles delitos. Según la Oficina Económica y Comercial de España en Luanda, casi todas las empresas españolas que operaron en Angola en 2021 sufrieron retrasos e

impagos. Además, se han señalado dificultades para el acceso al mercado por la preferencia de empresas locales en las compras públicas, además de existir trámites aduaneros complejos y dificultad de acceso a divisas.

El entorno empresarial es por tanto complejo; en el último indicador de facilidad de hacer negocios (Doing Business) publicado por el Banco Mundial (2022), se situaba a Angola en la posición 177 del total de 190 países indexados. A pesar de todo, Angola se sigue señalando como un país de oportunidades en diversos sectores: agroindustria, turismo, sector téxtil, producción y distribución eléctrica e infraestructuras de comunicación, entre otros. Incluso el proceso de privatizaciones a gran escala del gobierno, conocido como PROPRIV (Presidencia da República, 2019), supone también una oportunidad de entrada para el sector privado.

Para España, el continente africano es un importante proveedor de petróleo. Angola (alrededor del 3%) fue el cuarto suministrador de petróleo africano a España, por detrás de Nigeria (aproximadamente 10%), Libia y Argelia, según datos del Ministerio de Industria, Comercio y Turismo (2023) (tabla 11).

Tabla 11: Evolución de las importaciones españolas de Angola, principales capítulos arancelarios (miles euros, % s/ total)

CNAE	2017	2018	2019	2020	2021	2022
27 COMBUSTIB. ACEITES MINERALES	342.211,88 *(98,24%)*	374.598,50 *(97,25%)*	590.769,08 *(98,38%)*	290.464,58 *(97,89%)*	94.265,16 *(92,17%)*	289.586,84 *(96,29%)*
03 PESCADOS CRUSTÁCEOS, MOLUSCOS.	3.558,16 *(1,02%)*	7.555,05 *(1,96%)*	4.714,03 *(0,78%)*	2.878,75 *(0,97%)*	4.056,56 *(3,97%)*	4.882,56 *(1,62%)*
25 SAL YESO PIEDRAS, CEMENTO	1.428,61 *(0,41%)*	1.605,87 *(0,42%)*	2.657,47 *(0,44%)*	2.361,90 *(0,80%)*	3.659,38 *(3,58%)*	4.986,97 *(1,66%)*
08 FRUTAS /FRUTOS, S/ CONSERVAR	N.D. *(-%)*	920,16 *(0,24%)*	118,80 *(0,02%)*	540,00 *(0,18%)*	0,74 *(0,001%)*	178,91 *(0,06%)*
44 MADERA Y SUS MANUFACTURAS	135,62 *(0,04%)*	230,05 *(0,06%)*	343,97 *(0,06%)*	213,51 *(0,07%)*	215,64 *(0,21%)*	446,16 *(0,15%)*
09 CAFÉ TÉ YERBA MATE Y ESPECIAL	N.D. *(-%)*	58,98 *(0,02%)*	59,15 *(0,01%)*	0,07 *(0,00%)*	N.D. *(-%)*	107,79 *(0,04%)*
76 ALUMINIO Y SUS MANUFACTURAS	N.D. *(-%)*	N.D. *(-%)*	N.D. *(-%)*	177,19 *(0,06%)*	N.D. *(-%)*	0,59 *(0,00%)*
68 MANUFACTURAS DE PIEDRA, YESO	N.D. *(-%)*	N.D. *(-%)*	N.D. *(-%)*	51,41 *(0,02%)*	55,93 *(0,05%)*	186,66 *(0,06%)*
Total de Importaciones	**348.333,88**	**385.199,63**	**600.519,21**	**296.734,76**	**102.278,04**	**300.755,59**

Fuente: Elaboración propia a partir de datos de del Ministerio de Industria, Comercio y Turismo de España, 2023

5.2. Relaciones Comerciales Galicia-Angola

Angola es un atractivo destino de exportación con proyección de futuro. El país importa de España principalmente maquinaria, equipos y aparatos (17,99%), vehículos de motor (12,61%), productos siderúrgicos (6,92%) y otros bienes como material y equipo eléctrico (6,47%), y plásticos en menor medida (Oficina Económica y Comercial de España en Luanda, 2020). Además, destacaba en el país la demanda internacional de productos agroalimentarios y químicos (Oficina Económica y Comercial de España en Luanda, 2020; 2018).

Por otra parte, las exportaciones gallegas a Angola en 2022 no alcanzaron los 5 millones de euros, lo que resulta paradójico teniendo en cuenta las expectativas de crecimiento y desarrollo del país (tabla 12) y la proximidad cultural. También paradójicamente, algunas empresas gallegas, principalmente pesqueras, con clara vocación exportadora, sí consiguen vender cantidades de producto superiores en otros países lusófonos de menor dimensión como Cabo Verde. Casi el triple de lo que Galicia exporta a Angola.

Los sectores receptores de importaciones en España están en línea con los resultados provisionales de exportación observados para 2022, y con gran parte de la especialización exportadora de Galicia (centrada tradicionalmente en sectores como los productos agroalimentarios y la pesca, los transportes, la construcción e ingeniería o el textil, entre otros). También destacan en el caso angoleño las compras gallegas de sal y elementos de construcción, como yeso o piedras (tabla 13).

Además, el país está desarrollando actualmente su sector turístico, lo que podría suponer una oportunidad adicional para acceder al mercado.

Tabla 12: Evolución de las exportaciones gallegas a Angola, principales capítulos arancelarios (miles euros)

CNAE	2017	2018	2019	2020	2021	2022
84 MÁQUINAS Y APARATOS MECÁNICOS	996,30 *(12,98%)*	1.673,77 *(55,72%)*	828,39 *(28,89%)*	656,55 *(37,53%)*	1.007,14 *(45,44%)*	1.033,01 *(34,61%)*
89 BARCOS Y EMBARCACIONES	3.332,38 *(43,43%)*	32,00 *(1,07%)*	- *(-%)*	- *(-%)*	- *(-%)*	- *(-%)*
02 CARNE Y DESPOJOS COMESTIBLES	102,62 *(1,34%)*	332,12 *(11,06%)*	569,43 *(19,86%)*	500,92 *(28,63%)*	227,69 *(10,27%)*	341,27 *(11,43%)*
03 PESCADOS, CRUSTÁCEOS, MOLUSCOS	1.034,26 *(13,48%)*	225,50 *(7,51%)*	- *(-%)*	- *(-%)*	- *(-%)*	- *(-%)*
87 VEHÍCULOS AUTOMÓVILES; TRACTORES	19,95 *(0,26%)*	68,01 *(2,26%)*	353,99 *(12,34%)*	9,64 *(0,55%)*	291,84 *(13,17%)*	306,43 *(10,27%)*
85 APARATOS Y MATERIAL ELÉCTRICO	259,67 *(3,38%)*	82,88 *(2,76%)*	99,63 (3,47%)	65,26 *(3,73%)*	98,26 *(4,43%)*	236,26 *(7,92%)*
39 MAT. PLÁSTICAS; SUS MANUFACTU.	220,05 *(2,87%)*	3,14 *(0,10%)*	459,99 *(16,04%)*	0,32 *(0,02%)*	14,24 *(0,64%)*	9,94 *(0,33%)*
90 APARATOS ÓPTICOS, MEDIDA, MÉDICOS	16,55 *(0,22%)*	1,51 *(0,05%)*	19,90 *(0,69%)*	1,69 *(0,10%)*	0,51 *(0,02%)*	452,92 *(15,17%)*
94 MUEBLES, SILLAS, LÁMPARAS	479,74 *(6,25%)*	1,47 *(0,05%)*	4,46 *(0,16%)*	1,53 *(0,09%)*	16,44 *(0,74%)*	- *(-%)*
99 CONJUNT. DE OTROS PRODUCTOS	309,12 *(4,03%)*	152,75 *(5,08%)*	173,92 *(6,07%)*	162,45 *(9,29%)*	214,22 *(9,66%)*	254,59 *(8,53%)*
Total Exportaciones	**7.673,08**	**3.004,14**	**2.867,50**	**1.749,51**	**2.216,64**	**2.984,68**

Fuente: Elaboración propia a partir de datos de del Ministerio de Industria, Comercio y Turismo de España, 2023

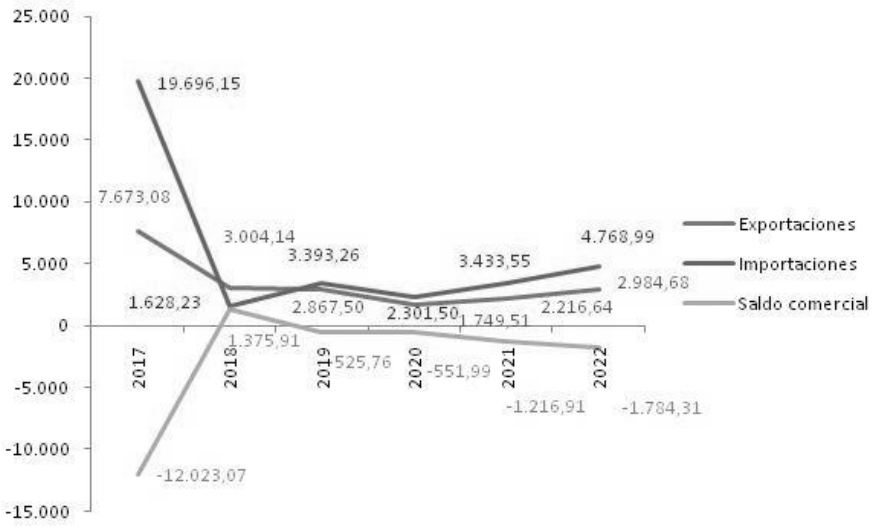
Tabla 13: Evolución de las importaciones gallegas de Angola, principales capítulos arancelarios (miles euros)

CNAE	2017	2018	2019	2020	2021	2022
27 COMBUSTIB. ACEITES MINERALES	18.305,59 *(92,94%)*	- *(-%)*	- *(-%)*	- *(-%)*	- *(-%)*	- *(-%)*
25 SAL, YESO, PIEDRAS S/ TRABAJAR	1.349,65 *(6,85%)*	1.539,47 *(94,55%)*	2.532,21 *(74,62%)*	2.240,81 *(97,36%)*	3.384,87 *(98,58%)*	4.705,26 *(98,66%)*
03 PESCADOS CRUSTÁCEOS, MOLUSCOS.	- *(-%)*	- *(-%)*	495,41 *(14,60%)*	- *(-%)*	- *(-%)*	- *(-%)*
08 FRUTAS /FRUTOS, S/ CONSERVAR	- *(-%)*	- *(-%)*	- *(-%)*	- *(-%)*	- *(-%)*	49,79 *(1,04%)*
44 MADERA Y SUS MANUFACTURAS	20,64 *(0,10%)*	47,09 *(2,89%)*	218,94 *(6,45%)*	13,50 *(0,59%)*	- *(-%)*	- *(-%)*
87 VEHÍCULOS AUTOMÓVILES; TRACTORES	13,63 *(0,07%)*	19,31 *(1,19%)*	145,64 *(4,29%)*	1,36 *(0,06%)*	0,11 (0,003%)	- *(-%)*
84 MÁQUINAS Y APARATOS MECÁNICOS	5,34 *(0,03%)*	18,72 *(1,15%)*	0,95 *(0,03%)*	7,14 *(0,31%)*	- *(-%)*	- *(-%)*
68 MANUFACTURAS DE PIEDRA, YESO	- *(-%)*	- *(-%)*	- *(-%)*	38,54 *(1,67%)*	35,40 *(1,03%)*	13,44 *(0,28%)*
Total Importaciones	**19.696,15**	**1.628,23**	**3.393,26**	**2.301,50**	**3.433,55**	**4.768,99**

Fuente: Elaboración propia a partir de datos del Ministerio de Industria, Comercio y Turismo de España, 2023

La actividad económica galaico-angoleña se caracteriza por una balanza comercial que presente generalmente saldos negativos para la Comunidad Autónoma para los últimos ejercicios (excepto en 2018). No obstante, el valor de las exportaciones podría estar recuperándose levemente tras la pandemia de COVID19 (figura 8), lo que abre expectativas y oportunidades de negocio futuras.

Figura 8: Evolución del Saldo Comercial Galicia-Angola, 2017-2022 (miles de euros)



Fuente: Elaboración propia a partir de datos del Ministerio de Industria, Comercio y Turismo de España, 2023

A continuación, se ha procedido a recopilar información sobre las principales empresas exportadoras gallegas a Angola durante la última década (tabla 14). Destaca la presencia de empresas relacionadas con la explotación de recursos pesqueros y agroalimentación, componentes industriales (especialmente del naval) e ingeniería, y empresas de otros sectores relacionados con la industria.

Tabla 14: Principales empresas exportadoras gallegas en Angola, 2014-2022

Empresas Pesca-Agroalimentación	Componentes industriales e ingeniería	Otras empresas
• INDUSTRIAS FRIGORIFICAS DEL LOURO SA • ZELNOVA SA • PESCANOVA SA • GRUPIMAR SL • PESCADOS RUBEN, SL, • NOVAFRIGSA SA • GRUPIMAR SL • BODEGAS TERRAS GAUDA SA • GAICTECH, SL	• INDUSTRIAS GUERRA SA • FLUIDMECANICA SA • MARALV MARINE SL UNIPERSONAL • ESPINA OBRAS HIDRAULICAS SA • TEMPE SA • ARDORA SA • INDUSTRIAS FERRI SA • BAITRA SL • INTERNACO SA • INDUSTRIA DE DISEÑO TEXTIL SA • TEMPE SA	• HERMANOS RODRIGUEZ GOMEZ SA • ANGEL LOPEZ SOTO SL • PROMENS IBERIA SA • PETER TABOADA SL

Fuente: Elaboración propia a partir de datos de la Cámara de Comercio Española (2023)

5.3. Análisis de oportunidades económicas para Galicia: análisis DAFO

El análisis efectuado nos ha llevado a señalar en la siguiente tabla los principales aspectos relacionados con las debilidades, amenazas, fortalezas y oportunidades de las relaciones económicas entre Galicia y Angola (tabla 15).

Tabla 15: Análisis DAFO de las relaciones económicas y comerciales Galicia-Angola

Debilidades	**Amenazas**
-Bajo nivel de renta per cápita del país destino. -Elevado nivel de desempleo de la población de Angola. -Escasa diversificación productiva de Angola por presencia del petróleo (las reservas probadas y probables de petróleo en Angola están estimadas en 12 billones 667 millones de barriles) y ausencia de incentivos para otros sectores. -Desconocimiento por gran parte del empresariado gallego del mercado en Angola.	-La tasa de fertilidad de 6,2 hijos por mujer, representa un enorme reto para la mejora de los indicadores de pobreza y desarrollo. -Posibles inestabilidades del precio del petróleo debido a conflictos bélicos externos. -Crisis económica en China, por ser este uno de los principales socios comerciales del país africano. -Pandemias y otros sucesos que puedan afectar a sectores económicos como el turístico u otros. -Impagos por falta de liquidez o informalidad en el mercado de destino.
Fortalezas	**Oportunidades**
- Angola es la quinta economía africana en términos de PIB y segundo productor de petróleo en África Subsahariana. -Recuperación de los precios del petróleo, lo que fortalecerá a la economía angoleña en próximas fechas. -Durante los últimos cincos años la economía del país africano registró un rápido crecimiento con una media de 18% por año, reforzando su capacidad adquisitiva y de negocio. -Reducción de la deuda pública del 79,7% respecto al PIB en 2021 al 56,5% en 2022 (FMI, 2022), lo que permite al país afrontar mayor contratación pública. -La innovación gallega está centrada en sectores específicos clave y con potencialidad exterior. El país africano posee y explota numerosos recursos naturales y mineros de interés, como petróleo, gas natural, cobre, fosfato, diamante, zinc, aluminio, oro, hierro, uranio, entre otros, además de poseer una rica fauna y flora. -Presencia de algunas pocas empresas exportadoras en sectores clave, que pueden actuar como "rompehielos" del mercado.	-Crecimiento poblacional esperado alcancen los 45 millones de habitantes en 2030 (United Nations Population Fund, 2020), y otras superan los 70 millones de habitantes en 2050 (PopulationPyramid, 2023). -El 66% de la población angoleña tiene actualmente menos de 25 años, lo que convierte al mercado laboral y a la reducción del desempleo juvenil en aspectos clave para el futuro de la economía del país. -Recuperación económica tras salir de una recesión de seis años (2016-2021). -Reformas normativas: Desde el punto de vista comercial, Angola prevé la eliminación de restricciones en la oferta de bienes y servicios. Estas medidas se complementarían a nivel fiscal con incentivos a la inversión productiva, en el marco de una nueva ley de inversión privada. -Diversos sectores atractivos para la inversión gallega, fundamentalmente la agricultura (sector en recuperación en el que destaca la producción de café, bovinos, algodón, maíz, azúcar, etc.) y pesca, la industria (refinado de petróleo, acero, textil, etc.) el transporte (con infraestructuras portuarias, ferroviarias y aeroportuarias relevantes), la construcción civil (en crecimiento tras la finalización de la guerra) y la minería (diamantes, petróleo, hierro cobre, manganeso, mica, fosfato, plomo, estaño, oro, plata, platino).

Fuente: Elaboración propia a partir del análisis efectuado

6- CONCLUSIONES: LA CONVENIENCIA DE PLANIFICAR EL APROVECHAMIENTO DE OPORTUNIDADES ECONÓMICAS

En un contexto de comercio mundial con mercados cada vez más competitivos y marcado por factores como la reciente crisis económica, la inestabilidad económica, política y social de muchos países y las turbulencias provocadas por la tensa relación entre bloques económicos como consecuencia de posiciones proteccionistas o librecambistas adoptadas ad hoc, se hace necesario afinar la estrategia económica exterior gallega. Incluir aspectos a nivel planificación, elaboración e implementación de política exterior y de internacionalización que permitan llevar a cabo un crecimiento

ordenado de las relaciones comerciales gallegas con países emergentes es conveniente. Aprovechar las afinidades socioeconómicas y culturales supone una oportunidad.

La proximidad psico-geográfica sirve de soporte a las relaciones comerciales, y la lengua "común" no ha llegado a representar todavía un motor relevante del comercio gallego con los países de la CPLP, a excepción de Portugal. En la situación actual, y en línea con Sande (2019) y Bruna (2007), se deberían considerar varias medidas para intensificar las relaciones comerciales y aumentar el volumen (en euros y en número de unidades) de las exportaciones a los países de la CPLP: a) Consolidar los mercados existentes, b) Promover la introducción de nuevos productos y servicios tecnológicos y c) Diversificar los mercados. Sin embargo, el presente análisis nos obliga a dar un paso más en relación con los análisis anteriores y a aclarar algunos aspectos.

1. El comportamiento de la economía de Angola y la sostenibilidad prevista de su deuda dependen en gran medida de un mercado de petróleo que, aunque si bien es actualmente favorable, es del todo impredecible. En un contexto de precios internacionales del crudo elevados, como en el ciclo actual, se genera una ingente cantidad de ingresos para el gobierno y garantiza el servicio de la deuda. Sin embargo, el sector extractivo ofrece una cantidad limitada de empleo y no contribuye necesariamente a la reducción de la pobreza (Marín, 2023).

2. Aunque actualmente Angola tiene una importancia media como suministrador de petróleo, no deja de ser uno de los mayores productores africanos. Además, las perspectivas de producción de crudo angoleño a medio plazo apuntan a un crecimiento importante, apoyado sobre todo por el incremento de las extracciones en el enclave de Cabinda.

3. El dilema económico de Angola está en seguir apostando por el sector del petróleo, que proporciona recursos y que afianza su posición como potencia energética y económica del continente, o diversificar y virar la economía a sectores menos estratégicos, como la agricultura y el sector servicios, que pueden absorber mayor cantidad de empleo.

4. En un contexto de paro juvenil desorbitado, que se sitúa alrededor del 60%, los objetivos gubernamentales pasan necesariamente por lograr una mayor inclusión laboral de este segmento de la población, y por la creación de trabajo. Si a este hecho se añade que las previsiones de evolución demográfica sitúan a Angola con más de 70 millones de habitantes/consumidores en 2050 (PopulationPyramid, 2023), no cabe duda de que para Galicia y España, Angola podría estar llamada a ser un socio económico de importancia creciente.

5. Hoy en día, Galicia cuenta con empresas que poseen conocimiento del mercado angoleño, pudiendo ejercer como puente de entrada. De igual manera, para aquellos sectores en los que esta relación no sea posible, las intensas relaciones económicas y comerciales con el vecino Portugal pueden servir como motor de conocimiento de mercados específicos del país africano, incluso mediante alianzas y colaboraciones estratégicas. Con todo, en determinados sectores como la construcción civil la estrategia comercial parece pasar más por la creación de asociaciones, consorcios o formas de colaboración similares con empresariado local.

6. De entre los sectores con mayores oportunidades de negocio en el país objeto de análisis, Galicia cuenta con especialización productiva y exportadora para, cuando menos, cuatro de ellos: industria (agroalimentación, maderera y textil), construcción civil, transporte (portuario, turismos y otra maquinaria) y agricultura y pesca. Sectores con necesidad de desarrollo, como el sanitario, podrían constituir también una oportunidad.

7. Un aspecto pendiente a nivel de políticas públicas es el fortalecimiento de la internacionalización de la innovación empresarial en Galicia. En este sentido, la especialización de la innovación en la autonomía presenta fortalezas para acceder a mercados como el angoleño, por coincidir las principales áreas de innovación gallegas con las manufacturas demandadas por parte de este país (transportes y automoción, madera y muebles, pesca, maquinaria y productos químicos, fundamentalmente). En este sentido, sería conveniente desde el punto de vista de Galicia desarrollar un plan comercial con Angola, que incluya la introducción de la innovación, y que esté basado en el marco normativo que ofrece la Ley Paz Andrade y la reciente Ley de Acción Exterior. Como primer paso sería conveniente promover mayores contactos con los agentes clave de la economía angoleña, como la embajada en España, así como promover la formación sobre el mercado de destino y las licitaciones públicas en el país, proveer espacios de reunión y de colaboración para innovar entre empresarios de ambos países para establecer alianzas estratégicas, además de fomentar la participación en ferias y eventos en destino.

Evidentemente, la acción exterior gallega y su impulso a través del fortalecimiento de las relaciones comerciales necesitan de otros incentivos y medidas de acompañamiento, como la promoción industrial, el fomento de infraestructuras modernas de transporte (principalmente el ferrocarril con Portugal, social estratégico) y tecnológicas, así como políticas tecnológicas más acordes y el fomento de la internacionalización de la I+D+i, o incentivos fiscales, entre otros. Una alianza con los países de la CPLP debería considerarse conveniente para restar importancia a otros mercados atractivos o emergentes y diversificar la actividad exterior.

Finalmente, un estudio riguroso como el presente debe incluir las principales limitaciones. En este sentido, cabe señalar que la informalidad de las relaciones económicas en el país angola constituye una limitación en su cuantificación, ya que para la misma se han empleado datos exclusivamente oficiales. Además, el análisis estadístico efectuado permite identificar asociaciones y correlaciones entre variables, pero no puede establecer causalidades. Por último, los resultados del presente trabajo no son generalizables a otras poblaciones o contextos, ya que responden a una realidad concreta (Angola) en un momento concreto.

REFERENCIAS

Altomonte, C., Aquilante, T., Békés, G., & Ottaviano, G. I. (2013). Internationalization and innovation of firms: evidence and policy. *Economic policy, 28(76)*, 663-700

Balassa, B. (1993). Outward Orientation. In: *Policy Choices for the 1990s*. Palgrave Macmillan, London. https://doi.org/10.1007/978-1-349-13033-7_1

Balassa, B. & World Bank. (1981). *Shifting patterns of world trade and competition*. World Bank

Banco Mundial. (2023). Índice de facilidad para hacer negocios [en línea]. Datos, en https://datos.bancomundial.org [ref. 19 de septiembre de 2023]. Disponible en https://datos.bancomundial.org/indicador/IC.BUS.EASE.XQ

Banco Nacional de Angola. (2018). Investimento Directo Estrangeiro por setor [en línea]. Dados Anuais, en https://www.bna.ao [ref. agosto de 2019]. Disponible en https://www.bna.ao/#/pt/estatisticas/estatisticas-externas/dados-anuais

Berlin, C. (2006). Forest Owner Characteristics and Implication for the Forest Owner Cooperative. Umeå, Sweden: Department of Forest Resource Management, Swedish University of Agricultural Sciences

Boermans, M. A., & Roelfsema, H. (2016). Small firm internationalization, innovation, and growth. *International Economics and Economic Policy, 13*, 283-296

Bruna, F. (2007). O comercio exterior de Galicia en 2007 e a política de internacionalización empresarial. Recuperado de www.ruc.udc.es [ref. from 21st of october of 2019]. Available in: https://ruc.udc.es/dspace/bitstream/handle/2183/15448/Bruna_2008_O_comercio_exterior_de_Galicia_e_a_pol%C3%ADtica_de_internacionalizacion_empresarial.pdf?sequence=5

Cámara de Comercio Española. (2023). Base de datos de comercio exterior [en línea]. Comercio Exterior, en https://www.camara.es [ref. 19 septiembre de 2023]. Disponible en: https://www.camara.es/comercio-exterior/base-de-datos-de-importaciones-y-exportaciones-en-espana

Cassiman, B., & Golovko, E. (2011). Innovation and internationalization through exports. *Journal of International Business Studies, 42*, 56-75

Castaño, M. S., Méndez, M. T., & Galindo, M. Á. (2016). Innovation, internationalization, and business-growth expectations among entrepreneurs in the services sector. *Journal of Business Research, 69(5)*, 1690-1695

Chen, T. Y., Liu, H. H., & Hsieh, W. L. (2009). The influence of partner characteristics and relationship capital on the performance of international strategic alliances. *Journal of Relationship Marketing, 8(3)*, 231-252

Chiang, C. F., Liu, J. T., & Wen, T. W. (2013). Individual preferences for trade partners in Taiwan. *Economics & Politics, 25(1)*, 91-109

Community of Portuguese Language Countries (CPLP). (2010): Declaração sobre 'cooperação, desenvolvimento e democracia na era da globalização'. Available at: https://www.cplp.org/Admin/Public/DWSDownload.aspx?File=%2FFiles%2FFiler%2Fcplp%2FC

CEG%2FIII_CCEG%2FDECLARA%EF%BF%BD%EF%BF%BDOSOBRECOOPMaputo2000.pdf

Cortés, E. C., & Ramón, D. Q. (2001). La dirección estratégica de la internacionalización de la empresa: propuesta de un marco teórico integrador. *Información Comercial Española, ICE: Revista de Economía, (794)*, 37-60

Enander, J., Melin, A. & Nilson, J. (2010): Trust-creating Social Networks in Forest Owners' Choice of Trading Partners. *Journal of Co-operative Studies, 43(3)*, 17-28

Filippetti, A., Frenz, M., & Ietto-Gillies, G. (2011). Are innovation and internationalization related? An analysis of European countries. *Industry and Innovation, 18(5)*, 437-459

FMI. (2022). Angola: 2021 Article IV Consultation and Six Review under the Extended Arrangement of the Extended Fund Facility and Request for a Waiver of Nonobservance of a Performance Criterion; Press Release; Staff Report; and Statement by the Executive Director for Angola [en línea]. IMF Staff Country Reports, en https://www.imf.org [ref. 18 enero de 2022]. Disponible en file:///C:/Users/Diego/Downloads/1AGOEA2022001.pdf

Fonseca, M., Mendonça, A. & Passos, J. (2010). Home country trade effects of outward FDI : an analysis of the Portuguese case, 1996-2007. *Faculdade de Economia. Universidade do Porto – Working Papers nº 365/ 2010*

García-Cabrera, A. M., & García-Soto, M. G. (2016). Calidad del entorno e internacionalización de la PYME: un análisis regional en España/Quality of the environment and SME's internationalisation: A regional analysis in Spain. *Emprendimiento y negocios internacionales, 1(1)*, 11-18

Hadjikhani, A., & Ghauri, P. N. (2001). The behaviour of international firms in socio-political environments in the European Union. *Journal of Business Research, 52(3)*, 263-275

IGADI. (2021). Novos tempos para a acción exterior de Galicia. Informe anual sobre a acción exterior de Galicia Nós no Mundo, 2021, 4-5. Available in: https://www.igadi.gal/web/sites/all/arquivos/igadi_weintheworld_2021.pdf

James Jr, H. S. & Sykuta, M. E. (2006). Farmer trust in producer- and investor-owned firms: Evidence from Missouri corn and soybean producers, *Agribusiness. An International Journal, 22*, 135–153

Kafouros, M. I., Buckley, P. J., Sharp, J. A., & Wang, C. (2008). The role of internationalization in explaining innovation performance. *Technovation, 28(1-2)*, 63-74

Kali, R., Méndez, F., & Reyes, J. (2007). Trade structure and economic growth. *The Journal of International Trade & Economic Development, 16(2)*, 245-269

Ke, W. & Wei, K.K. (2007). Factors affecting trading partners' knowledge sharing: Using the lens of transaction cost economics and socio-political theories. *Electronic Commerce Research and Applications, vol. 6(3)*, 297-308. DOI: https://doi.org/10.1016/j.elerap.2006.06.006

Kubíčková, L., Votoupalová, M., & Toulová, M. (2014). Key motives for internationalization process of small and medium–sized enterprises. *Procedia Economics and Finance, 12*, 319-328

Lee, S-H, Peng, M.W. & Barney, J.B. (2007). Bankruptcy law and entrepreneurship development: a real options perspective. *Academy of Management Review 32 (1)*, 257-272.

Leung, T. Y., & Sharma, P. (2021). Differences in the impact of R&D intensity and R&D internationalization on firm performance–Mediating role of innovation performance. *Journal of Business Research, 131*, 81-91. DOI: https://doi.org/10.1016/j.jbusres.2021.03.06

Levinson, N.S. & Asahi, M. (1995). Cross-national alliances and interorganizational learning *Organizational Dynamics, 24 (2)*, 50-63

Marín, A. (2021). África: mercado en auge y dinámicas de desarrollo Las empresas canarias como caso de estudio [en línea]. *Elcano Policy Paper, vol. 2020,* 1-60. Real Instituto Elcano, en https://media.realinstitutoelcano.org [ref. diciembre de 2021]. Disponible en https://media.realinstitutoelcano.org/wp-content/uploads/2022/03/policy-paper-africa-mercado-en-auge-y-dinamicas-de-desarrollo.pdf

Marín, A. (2023). Angola: situación política, dilema económico y relaciones bilaterales con España [en línea]. Real Instituto Elcano, Temas, en https://www.realinstitutoelcano.org [ref. 13 de febrero de 2023]. Disponible en https://www.realinstitutoelcano.org/analisis/angola-situacion-politica-dilema-economico-y-relaciones-bilaterales-con-espana/

Martínez-Román, J. A., Gamero, J., de Loreto Delgado-González, M., & Tamayo, J. A. (2019). Innovativeness and internationalization in SMEs: An empirical analysis in European countries.

Technological. *Forecasting and Social Change, 148*, 119716. DOI: https://doi.org/10.1016/j.techfore.2019.119716

Ministerio de Asuntos Exteriores. (2023). Ficha País. República de Angola [en línea]. Oficina de información diplomática, en https://www.exteriores.gob.es [ref. 1 de septiembre de 2023]. Disponible en: https://www.exteriores.gob.es/documents/fichaspais/angola_ficha%20pais.pdf

Ministerio de Industria, Comercio y Turismo. (2023). Últimos datos de Comercio Exterior de Bienes en España [en línea]. ICEX, en https://www.icex.es [ref. 20 septiembre de 2023]. Disponible en: https://datacomex.comercio.es/

Moncloa. (2021). Ingreso de España en la Comunidad de Países de Lengua Portuguesa como Observador Asociado. Recover from *Asuntos Exteriores, Unión Europea y Cooperación* [ref. 28 october, 2022]. Available in: https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/exteriores/Paginas/2021/170721portugues.aspx

Nilsson, J., Kihlén, A. & Norell, L. (2009). Are traditional cooperatives an endangered species? About shrinking satisfaction, involvement, and trust. *International Food and Agribusiness Management Review, 12,* 103–123

Oficina Económica y Comercial de España en Luanda. (2018). *Informe Económico y Comercial de Angola*. Luanda: Oficina Económica y Comercial de España en Luanda

Oficina Económica y Comercial de España en Luanda. (2020). Informe económico y comercial. Angola [en línea]. ICEX, en https://www.ivace.es [ref. 18 de septiembre de 2023]. Disponible en https://www.ivace.es/Internacional_Informes-Publicaciones/Pa%C3%ADses/Angola/Angolainformeicex2020.pdf

Oficina Económica y Comercial de España en Luanda. (2021). Informe económico y comercial. Angola [en línea]. ICEX, en https://www.icex.es [ref. 18 de septiembre de 2023]. Disponible en https://www.icex.es/content/dam/es/icex/documentos/quienes-somos/donde-estamos/red-exterior/angola/DOC2020860209.pdf

Österberg, P. & Nilsson, J. (2009). Members' Perception of their Participation in the Governance of Cooperatives: The Key to Trust and Commitment in Agricultural Cooperatives. *Agribusiness. An International Journal, 25*, 181–197

Pastelakos, E., Theodoraki, C., & Catanzaro, A. (2023). The role of innovation and internationalization support in small-and medium-sized enterprises' export performance. *European Management Review, 20(1)*, 31-47. DOI: https://doi.org/10.1111/emre.12513

Peng, M. W. (2006). *Global Strategy*. Cincinnati, Ohio: South-Western Thomson

PopulationPyramid (2023). Densidad de población [en línea]. Population Pyramid, en https://www.populationpyramid.net [ref. 15 de marzo de 2023]. Disponible en https://www.populationpyramid.net/es/angola/2050/

Presidencia da República. (2019). Decreto Presidencial n.º 250/19 de 5 de Agosto. Programa de Privatizações para o Período 2019-2022 [en línea]. Diário da República, en https://www.ucm.minfin.gov.ao [ref. 5 agosto de 2019]. Disponible en: https://www.ucm.minfin.gov.ao/cs/groups/public/documents/document/zmlu/ode1/~edisp/minfin815554.pdf

Reve, T. & Stern, L.W. (1986). The relationship between interorganizational form, transaction climate, and economic performance in vertical interfirm, en L. Pellegrini, S. Reddy (Eds.), Marketing Channels – *Relationships and Performance*, Lexington Books, Lexington, MA (1986)

Roder, A. & Da Silva-Rego, B.F. (2018). The Economic Face of International Co-operative Arrangements: The Cases of IBSA and CPLP. Contexto int. 40 (01). DOI: https://doi.org/10.1590/S0102-8529.2017400100007

Rousseau, D.M., Sitken, S.B., Burt, R.S.& Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of Management Review, 23 (1)*, 393–404

Sande, D. (2019). Oportunidades de expansión do Comercio Exterior de Galicia: as relacións comerciais coa Comunidade de Países de Lingua Portuguesa (CPLP). *Tempo Exterior, Nº 39*, *vol. XX (I),* 135-154

Sande, D. (2020). *O estrangulamento tecnolóxico de Galiza. Análise das políticas europeas de innovación rexional durante a Gran Recesión*. Santiago de Compostela: Laiovento

Sande, D. (2022a). Large Companies Vs SMEs: Who shows the greatest impact of the Structural Funds for business innovation in peripheral regions? Analysis of the results of the Technology Fund 2007-2013 in Galicia. *Revista Portuguesa de Estudos Regionais, nº62,* 57-76. DOI: https://doi.org/10.59072/rper.vi62.560

Sande, D. (2022b). Is there an impact of the European Regional Innovation Policies on enterprises? An analysis of the ERDF-Innterconecta programme of the Technology Fund 2007-2013 in Galicia. *Cuadernos Europeos de Deusto, vol. 66,*101-132. DOI: https://doi.org/10.18543/ced662022

Sande, D. (s.f.). Galician trade relations with the Community of Portuguese-speaking Countries. How to deal with them? *Revista de Estudios Regionales*

Sande, D. & Sande, J.R. (2023). Evaluación de las políticas europeas de innovación empresarial en el sector tecnológico medioambiental: Análisis de la ejecución del Programa FEDER- Innterconecta del Fondo Tecnológico 2007-2013 en Galicia. *Revista de Estudios Regionales, nº 126*, 86-121

Sande, D. & Vence, X. (2019). Avaliación do impacto do Programa Fondo Tec-nolóxico 2007-2013 en Galicia: resultados, concentración das axudas e fugas de recursos. *Revista Galega de Economía, Vol 28(3)*, 92-114. DOI: http://dx.doi.org/10.15304/rge.28.3.5926

Sande, D. & Vence, X. (2021). Impact of Structural Funds for Innovation on the business innovation: analysis through the indicators of the companies participa-ting in the ERDF-Innterconecta programme in Galicia. *Revista Galega de Economía, vol. 30(2),* 1-16. DOI: https://doi.org/10.15304/rge.30.26865

Sarmiento, S. (2014). Estratégias de internacionalización y globales para países en desarrollo y emergentes. *Revista Dimension Empresarial, vol. 12, núm. 1*, 111-138

Savelyev, M., Kutyashova, E., Savchenko, A., Koretsky, V., & Polyakov, Y. (2021). Diversity of economic development in Portuguese-speaking countries. In *SHS Web of Conferences (Vol. 101). EDP Sciences*

Singer, P. (1976). Urbanización, dependencia y marginalidad en América Latina. *CEPAL*. Disponible en: https://repositorio.cepal.org/items/d6f28bc0-76a3-42b3-86de-d2be025eb695

Sommer, D., & Bhandari, K. R. (2022). Internationalization of R&D and innovation performance in the pharma industry. *Journal of International Management, 28(3)*, 100927. DOI : https://doi.org/10.1016/j.intman.2022.100927

Song, S., & Lee, S. (2020). Motivation of internationalization and a moderating role of environmental conditions in the hospitality industry. *Tourism Management, 78*, 104050. DOI : https://doi.org/10.1016/j.tourman.2019.104050

United Nations Population Fund. (2020). Annual Report 2020 [en línea]. United Nations, en https://www.unfpa.org [ref. 20 septiembre 2023]. Disponible en https://www.unfpa.org/annual-report-2020

Velez-Ocampo, J., & Gonzalez-Perez, M. A. (2022). Internationalization and capability building in emerging markets: what comes after success?. *European Management Review, 19(3)*, 370-390. DOI : https://doi.org/10.1111/emre.12487

Voudouris, I., Lioukas, S., Makridakis, S. & Spanos, Y. (2000). Greek hidden champions: Lessons from small, little-known firms in Greece. *European Management Journal, 18(6)*, 663-674

Xunta de Galicia. (2014). Lei 1/2014, do 24 de marzo, para o aproveitamento da lingua portuguesa e vínculos coa lusofonía. DOG Núm. 68, de 8 de abril de 2014. Available in: https://www.xunta.gal/dog/Publicados/2014/20140408/AnuncioC3B0-310314-0001_gl.html

Xunta de Galicia. (2018). Estratexia Galega de Acción Exterior. Horizonte post 2020. Recuperado de www.cpapx.xunta.gal [ref. From the 31st of october of 2019]. Available in: https://cpapx.xunta.gal/c/document_library/get_file?folderId=345857&name=DLFE-32303.pdf

Xunta de Galicia. (2021). Lei 10/2021, de 9 de marzo, reguladora da acción exterior e da cooperación para o desenvolvemento de Galicia. DOG número 50, de 15 de marzo de 2021. Available in: https://www.xunta.gal/dog/Publicados/2021/20210315/AnuncioC3B0-090321-0001_es.html

Yasushi, S. (2013). Internal and external aspects of internationalization. In *The internationalization of Japan* (pp. 72-103). Routledge

Yu, X., & Si, S. (2012). Innovation, internationalization and entrepreneurship: A new venture research perspective. *Innovation, 14(4)*, 524-539

Zeuli, K. & Betancor, A. (2005). The effects of cooperative competition on member loyalty. Paper presented at the NCERE-194 2005 Annual Meeting, Minneapolis, MN, November 8–9

Zevallos, M. E. (2020). Factores determinantes en la internacionalización empresarial según los enfoques Uppsala y de recursos: una revisión de casos en PYMES de Perú, Colombia y España

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Measuring Local Entrepreneurial Ecosystems: Insights from Portuguese Sub-Regions

Medição de Ecossistemas Empreendedores Locais: Perspectivas das Sub-Regiões Portuguesas

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Abstract

Over the years, Entrepreneurial Ecosystems (EEs) have gained significant attention from scholars and policymakers, becoming a pivotal framework for understanding entrepreneurship's importance in regional development dynamics. However, the existing literature presents several theoretical and empirical gaps, often neglecting the specificities of the local context. This paper aims to address this void by conducting a quantitative analysis of local EEs, using data from 25 Portuguese sub-regions. Drawing upon established EE theory, the study calculates the Portuguese Local EE Index, comprising 17 indicators and a Penalty for Bottleneck methodology. Correlation and regression analyses shed light on the relationships between local EEs and entrepreneurship outputs and socio-economic indicators. The findings also underscore the critical role of leadership, market demand, and access to financial capital as focal points for tailored policy interventions to address these local bottlenecks. Moreover, the study identifies urban-rural disparities, advocating for policies that bridge geographical divides and unlock the potential of rural entrepreneurship. Furthermore, significant variability is found within each region, highlighting the importance of adopting a local perspective when developing EEs. By advancing our understanding of local EE dynamics, this research contributes to a more nuanced discourse on entrepreneurship and informs evidence-based policymaking aimed at cultivating more vibrant and resilient entrepreneurial economies.

Keywords: entrepreneurial ecosystems; local development; resilience; entrepreneurship; regions; public policy.

JEL Codes: P25; R58; L26; L38

Resumo

Ao longo dos anos, os Ecossistemas Empreendedores (EEs) têm merecido grande atenção por parte de académicos e decisores políticos, tornando-se um importante modelo para a compreensão da importância do empreendedorismo nas dinâmicas de desenvolvimento regional. No entanto, a literatura existente apresenta várias lacunas frequentemente negligenciando as especificidades do contexto local. Este artigo pretende colmatar esta lacuna através de uma análise quantitativa a nível local, utilizando dados de 25 sub-regiões portuguesas. O estudo calcula o Índice Local EE Portugal, composto por 17 indicadores e uma metodologia de penalização por estrangulamento. As análises de correlação e regressão esclarecem as relações entre os EEs, a atividade empreendedora e indicadores socioeconómicos. Os resultados sublinham o papel da liderança, do mercado e do acesso a capital financeiro como pontos críticos a nível local e regional. Além disso, são identificadas disparidades urbano-rurais, defendendo-se políticas para superar as divisões geográficas e desbloquear o potencial do empreendedorismo rural. Por fim, é encontrada uma variabilidade significativa dentro de cada região, destacando a importância de adoptar uma perspectiva local ao desenvolver EEs. Ao avançar na compreensão das dinâmicas locais dos EEs, esta investigação contribui para um discurso mais sistematizado sobre o empreendedorismo, melhor informando a elaboração de políticas destinadas a promover economias locais empreendedoras, vibrantes e resilientes.

Palavras-Chave: ecossistemas empreendedores; desenvolvimento local; resiliência; empreendedorismo; regiões; políticas públicas.

Códigos Jel: P25; R58; L26; L38

INTRODUCTION

In the last decade, Entrepreneurial Ecosystems (EEs) have gained widespread attention from researchers and policymakers, resulting in a proliferation of studies in this field (Spigel, Kitagawa, and Mason 2020). However, despite the growing interest in EEs, empirical evidence, particularly using quantitative approaches, remains scarce (Leendertse, Schrijvers, and Stam 2021; Liguori et al. 2019). Many existing studies have focused on individual success cases, posing challenges in replicating findings across different regions or countries, and often lacking robust theoretical foundations or precise and comparable metrics (Nicotra et al. 2018).

Consequently, several scholars have emphasized the importance of securing a balance between quantitative and qualitative approaches to better understand the diverse contexts of EE (Spigel, Kitagawa, and Mason 2020). Recent efforts have seen the development of tools for measuring EEs through empirical quantitative analyses using primary or secondary data. Nonetheless, many of these studies tend to concentrate on specific case studies that may be difficult to extrapolate, or on the national (Radosevic and Yoruk 2013; Corrente et al. 2019) or regional levels (Leendertse, Schrijvers, and Stam 2021), overlooking the significant variation in entrepreneurial inputs and outputs within those regions or countries.

To address this gap, this study aims to examine EEs at the local level, acknowledging the substantial variability of local EEs across different regions and territories. It adopts the recommendations of various authors working on EEs (Liguori et al. 2019; Wurth, Stam, and Spigel 2021) and builds upon the framework proposed by Stam and van de Ven (2021). The framework encompasses ten elements and seventeen indicators to measure EE quality, along with four indicators to measure entrepreneurship outputs, and five indicators to assess local socio-economic development. Furthermore, it explores the interrelationships between these elements and develops an EE index using the Penalty for Bottleneck methodology. Moreover, potential associations between EE quality, entrepreneurship outputs, and local socio-economic development are verified. Additionally, we identify critical bottlenecks such as leadership, demand, and finance, offering actionable insights for policymakers to tailor interventions that bolster the overall quality of EEs.

By depicting the complex dynamics of local EEs, this study contributes to the empirical evidence on EEs and offers policymakers valuable insights for promoting entrepreneurship and innovation as local development strategies.

This paper first discusses the theoretical background of EEs, presenting several examples of previous attempts to measure EEs at local and regional level. Following that, section 2 presents the methodology, research context and indicators and data sources used. Thirdly, it presents the main results regarding descriptive analysis, regression analysis and bottlenecks identified, being discussed and compared with other studies on the topic. Finally, the main conclusions are presented, discussing implications for policymaking, as well as the limitations of this study and further research suggestions.

1. ENTREPRENEURIAL ECOSYSTEMS

Entrepreneurship does not occur in a vacuum, as it flourishes within a supportive environment conducive to innovation and business development (Cowell, Lyon-Hill, and Tate 2018). Hence, the concept of the EE has emerged as a place-based perspective suitable for understanding entrepreneurship within broader geographical, temporal, and social contexts (Alvedalen and Boschma 2017). Building upon previous concepts such as innovation systems, clusters, industrial districts, and entrepreneurial support networks, the EE concept offers an integrative and distinct viewpoint on the complex and diverse interactions between actors and environmental elements shaping the entrepreneurial performance of a region or locality (Stam 2015).

Despite the exponential growth of research publications and policy papers on EE (Spigel, Kitagawa, and Mason 2020), the concept still lacks strong theoretical foundations and empirical support (Kansheba and Wald 2020; Alvedalen and Boschma 2017). These documents have identified four main research challenges in EE research: theoretical foundations and frameworks, dynamic and longitudinal perspectives, empirical work, and applicability to other contexts. Addressing these challenges is crucial for advancing EE research and informing effective policy interventions.

1.1. Local Entrepreneurial Ecosystems

Each EE is shaped by the combination of physical and formal elements, as well as the perceptions and relationships of the local actors (Muñoz et al. 2020). The unique socio-cultural environment, available resources, networks, and geographical conditions of a location shape the interactions between the stakeholders, ultimately impacting the success or failure of adopted policies and strategies (Mason and Brown 2014; Xu and Dobson 2019). Due to variations in location, the elements and contextual conditions of EE frameworks may vary and their interactions across different spatial levels can be (dis)aggregated, making it essential to adopt multi-actor, multi-level, and multi-scalar approaches (Wurth, Stam, and Spigel 2021). Therefore, a place-based perspective becomes imperative to comprehend how entrepreneurship influences a territory's development.

Nevertheless, research on EEs has predominantly focused on specific ecosystems rather than employing a multi-scalar approach (Wurth, Stam, and Spigel 2021). Most authors have concentrated their efforts on the national or regional level, due to the availability of national or regional statistics. Current EE models and policies often adopt a one-size-fits-all approach, which may not be suitable for every local ecosystem. However, it is important to recognize that each region encompasses multiple unique local ecosystems that may complement or compete with one another (Muñoz et al. 2020). Consequently, calls have been made for new conceptual and methodological approaches that capture the diversity of conditions and outcomes, recognizing the distinctiveness of each local EE (Muñoz et al. 2020; Freitas and Kitson 2018).

Comparative analyses of EEs, whether across different points in time or between different EEs, have become crucial in both EE research and policymaking (Corrente et al. 2019). Various tools, such as Global Entrepreneurship Monitor, World Bank indicators, World Economic Forum index, or the Organization for Economic Co-operation and Development (OECD) measures, have

been introduced in recent years to capture EE attributes (Liguori et al. 2019). However, most of these tools primarily focus on the national level, making it challenging to adapt them for regional or local analysis (Liguori et al. 2019). Despite these challenges, there are some studies and reports that analyse EEs at the regional and local level, awakening a growing interest among researchers and policymakers.

Early attempts to measure EE quality at the regional level include the 'Regional Entrepreneurship & Development Index (REDI)' (Szerb et al. 2017) and the 'Regional Ecosystem Scoreboard (RES)' (León et al. 2017), two European policy instruments that were developed to assess the entrepreneurial environment and development prospects within specific regions. More recently, Sternberg, von Bloh, and Coduras (2019) undertook measurements of EEs' quality at the regional level in two German and two Spanish NUTS-2 regions, drawing upon Stam's (2015) framework and using a survey to measure the perception of the people and organizations within these regions. Similarly, Liguori et al. (2019) employed an approach based on capturing entrepreneurs' perceptions of the ecosystem to measure EEs performance. On the other hand, Leendertse, Schrijvers, and Stam (2021) and Mikic, Horvatinovic, and Kovac (2020) used secondary data to measure EEs at the regional level in 273 European Regions (NUTS-2), also drawing upon Stam 2015 proposed elements.

At the local level, studies are relatively scarce. Stam and van de Ven 2021 measured EEs at the provincial level in The Netherlands, while Iacobucci and Perugini 2021 and Perugini 2022 conducted similar analyses in Italy.

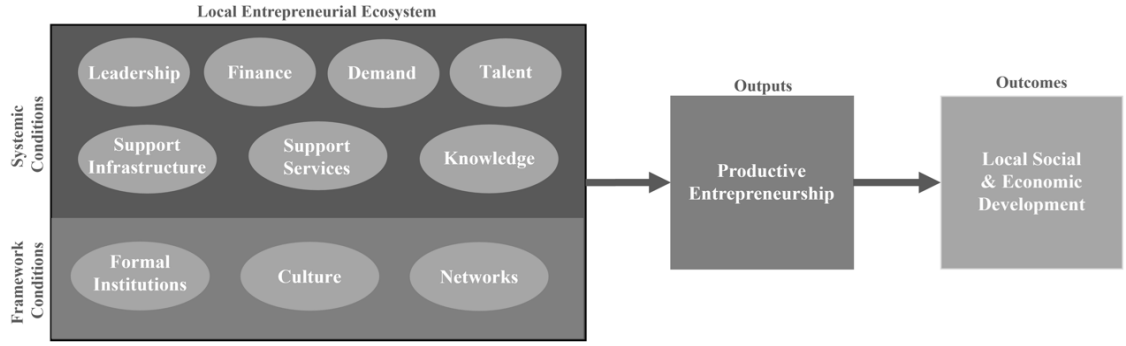
Despite the novelty of contributions, these approaches face challenges in scaling up and conducting longitudinal analyses due to data limitations (Liguori et al. 2019; Spigel, Kitagawa, and Mason 2020) or the unavailability of local-level data (Iacobucci and Perugini 2021). Thus, this study aims to contribute to EE research at the local level and respond to the call for further research "in other contexts, potentially revealing different relations between the entrepreneurial ecosystem and its outputs" (Stam and van de Ven 2021, 829).

2. METHODOLOGY

2.1. Research Framework

This study builds upon Stam and van de Ven 2021 framework, gathering insights from the empirical studies to EE at local and regional levels discussed in the previous section. The Local Entrepreneurial Ecosystem (LEE) comprises ten elements, categorized into three framework conditions (formal institutions; culture; and networks) and seven systemic conditions (leadership, finance, demand, talent, support infrastructure, support services, knowledge). These elements have been widely acknowledged in seminal works within the EE literature, capturing the fundamental conditions necessary for entrepreneurship to thrive in a given location (Isenberg 2010; Stam 2015). The framework considers productive entrepreneurship as the primary output of the LEE, and the local social and economic development as the principal outcome. A detailed description and discussion of each element are provided in the 'Indicators and Data Sources' section.

Figure 1 – Local Entrepreneurial Ecosystem Framework. Adapted from Stam and van de Ven 2021.



2.2. Research Context

Portugal is a European country with just over ten million inhabitants. The country is divided into seven regions (NUTS 2) and 25 sub-regions (NUTS-3), according to the European Union nomenclature (see Table 4)[1]. The Portuguese regions and sub-regions lack political autonomy (except for the Autonomous Region of Madeira and the Autonomous Region of Azores). While some boundaries are subject to political discussions, these spatial divisions were established based on shared historical and common characteristics among municipalities, and numerous institutions operate within these boundaries.

Regarding entrepreneurship and innovation (ecosystems), various studies suggest that Portugal has been increasing its national EE quality and entrepreneurship outputs in recent years (Singh and Ashraf 2020; Pita, Costa, and Moreira 2021; Almeida, Daniel, and Botelho 2023). This is supported by reports from the Global Entrepreneurship Monitor, indicating growth in entrepreneurial self-perceptions and activity in Portugal (GEM 2019).

At the regional level, Leendertse, Schrijvers, and Stam (2021) work on the European NUTS-2 regions showed that all Portuguese regions, except for the capital region (AM Lisboa), have EE index scores far below the European average. These disparities among Portuguese NUTS-2 regions are also reflected in innovation indicators, where *Norte*, *Centro* and *AM Lisboa* regions are considered Moderate Innovators, while the remaining regions (*Alentejo*, *Algarve*, *RA Açores* and *RA Madeira*) are considered Emerging Innovators (European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs 2021). At the local level, (Silva and Teixeira (2012) mapped the local political entrepreneurship confirming a positive impact in the creation of local businesses, and finding significant variation among different regions. More recently, Subtil et al. (2023) confirmed this important role of local governance in Portuguese LEEs development.

This study focuses on the 25 Portuguese sub-regions (NUTS 3) as the unit of analysis. This spatial level presents a compromise between the lower institutional level (municipality), which is too disaggregated due to the people and firms operating outside their municipality of origin, and the broader levels (regional and national) which do not allow to capture the high internal variability that significantly influences entrepreneurship and innovation (Iacobucci and Perugini 2021).

2.3. Indicators and Data Sources

In this section, we provide the definitions and operational measures for the EE elements, outputs and outcomes, used in the research framework outlined above. The selection of indicators was based on their relevance, analytical robustness, timeliness, and accessibility. The starting point for the selection was the empirical studies on EEs at the regional and local levels presented in section 1.1., as many authors have already tested and confirmed the significance of some indicators which ease the selection process. Afterwards, the initial pool of indicators was tailored to the availability of data within the Portuguese context and at the sub-regional level. The data collected range from 2015 to 2021, being mainly used that from 2018. The final set of indicators consisted in seventeen indicators to measure EE quality, four indicators to measure EE outputs, five indicators to measure EE outcomes, and one control variable. These indicators are summarised in Table 1.

2.3.1. Entrepreneurial Ecosystem Elements

Formal Institutions. The quality and efficiency of formal institutions are essential for entrepreneurship (Stam and van de Ven 2021). The institutional environment and regulatory framework for businesses, can boost or hinder entrepreneurs to further develop their ideas (León et al. 2017; Leendertse, Schrijvers, and Stam 2021). We use data from the Local Quality of Governance

[1] In this study, we followed NUTS-2013 classification. We acknowledge the recent redefinition in Portuguese regions with NUTS-2024, however since the data was collected prior to this new division, we use the previous classification.

Index of Portugal presented by Tavares et al. (2018). It measures the quality of governance of the 308 Portuguese Municipalities (NUTS 4), using 22 indicators divided into five dimensions: citizen voice and accountability; political stability; government effectiveness; market access and regulation; rule of law and prevention of corruption. The data was aggregated into 25 sub-regions (NUTS 3) using an average aggregation procedure. As this study focuses only on one country, country-level indicators such as the legal system, regulations or taxation or level of bureaucracy were not included.

Entrepreneurial Culture. It reflects the degree to which entrepreneurship is valued and facilitated in a society (Sternberg, von Bloh, and Coduras 2019), fostering or hindering (potential) entrepreneurs to develop their ideas (León et al. 2017). There are different types of methods and indicators to measure entrepreneurial culture (Credit, Mack, and Mayer 2018). We measure entrepreneurship culture indirectly with the prevalence of new firms, which indicates how 'common' it is to start a business in the sub-region. This is a common indicator used in other EE empirical studies (Mikic, Horvatinovic, and Kovac 2020).We also include a more qualitative indicator from the European Social Survey related to the population opinion on the 'importance to be innovative and have new ideas'. This indicator was already used in other EE empirical studies (Leendertse, Schrijvers, and Stam 2021).

Networks. This element covers the interactions among the different players in an ecosystem (Sternberg, von Bloh, and Coduras 2019), being measured by the percentage of businesses in a region that collaborate for innovation, based on data of the Community Innovation Survey (CIS). This indicator may not include other micro businesses or other non-business players of the ecosystem, as well as, not covering the nature and quality of the interactions among the local stakeholders. However, this was an indicator already used in other EE empirical analyses at the local and regional level as the best proxy to measure this element (Stam and van de Ven 2021; Leendertse, Schrijvers, and Stam 2021).

Support Infrastructure. Physical infrastructure, such as accessibility to roads, railroads and airports, as well as, digital infrastructure are essential to promote interactions between ecosystem players and ensure an adequate flow of resources (Mikic, Horvatinovic, and Kovac 2020; Leendertse, Schrijvers, and Stam 2021). We use three empirical indicators to measure the physical and digital context that enables the connection between EE stakeholders. Two of the indicators are related to the transportation infrastructure regarding road (Dijkstra, Poelman, and Ackermans 2019) and rail accessibility (Cruz et al. 2021). Other indicators regarding passenger flights, for example, were not considered given the lower spatial level of the analysis. The third indicator is related to the digital infrastructure and is measured by the percentage of the population with access to the internet. Other relevant indicators such as broadband accessibility were not available at the sub-regional level.

Demand. It is measured using two indicators: one related to potential market demand, measured by the number of inhabitants; and other the related to the population's capacity to purchase goods and services, measured by the purchasing power per capita. This element is the most complex to measure, since in todays's globalised world companies, especially for high-growth firms, are most likely to serve markets outside their spatial boundaries.

Leadership. The importance of lead actors in fostering a healthy EE has been well-established (Porras-Paez and Schmutzler 2019). One indicator used to measure leadership is the prevalence of innovation project leaders within a sub-region, as determined by data from the Horizon 2020 projects database. This metric has been employed in previous empirical analyses on EE (Leendertse, Schrijvers, and Stam 2021).

Finance. The access to various sources of debt and equity, both formal and informal, is an essential requirement for the growth and sustainability of new ventures (Miles and Morrison 2020). To measure finance, this study employed three indicators, where one pertained to venture capital and was measured by the number of investors registered in the sub-region on the Crunchbase platform; and the other two indicators were based on investment in innovation and entrepreneurship through European funds databases over an eight-year period.

Talent. It is related to the availability of qualified human capital, crucial to the existing and potential companies' growth. It is measured by the percentage of the population with higher

education. Other indicators related to skills and training commonly used in this element were not available at the local level.

Knowledge. Investments in new knowledge are an important source of entrepreneurial opportunities. The indicator used for the knowledge element is the amount invested in R&D (by public and private organizations) as share of the GDP. This is a widely used indicator to measure the knowledge production in a given region.

Support Services. The presence of business services can substantially lower the barriers to new value creation (Stam and van de Ven 2021). Besides the existence of incubators and science parks which support the local EE (Sternberg, von Bloh, and Coduras 2019), we include the percentage of support services firms on the total number of businesses in the sub-region, and the number of technological infrastructures per 1000 inhabitants.

2.3.2 Outputs

We measured productive entrepreneurship using three indicators – the number of firms registered on the Crunchbase platform, the number of new medium-high technology firms, and the number of high-growth firms. These indicators represent the best proxy to productive entrepreneurship, being commonly used in other EE studies (Stam and van de Ven 2021; Leendertse, Schrijvers, and Stam 2021; Mikic, Horvatinovic, and Kovac 2020). Additionally, a fourth indicator related to the survival rate of new firms, to understand if the LEE is related to higher or lower survival of new firms.

2.3.3 Outcomes

The main outcome of the LEE is the local social and economic development of the territory. This is measured using five indicators. One relates to economic development – GDP per capita; two related with social development – the population change in the last ten years and the quality of life of the region; and two related to the resistance to crises – measured by changes in the unemployment rate change and the GDP per capita change during the first year of the pandemic. Regarding this last indicator, we consider the first year of the pandemic as the period during the shock, coinciding with the peak of unemployment of the country, following Iacobucci and Perugini (2021) work which measure resilience by looking at the variations of GDP or employment at local level: during the shock (resistance) and soon after it (recovery).

2.3.4 Control Variable

The degree of urbanisation classifies the Local Administrative Units (LAUs) in Europe into three types of areas (cities, towns and suburbs, and rural areas), based on the share of the local population living in urban clusters and urban centres (Eurostat 2022). This indicator was used in this study as a control variable to understand how the EE index performs across urban and rural areas.

Table 1 - Description of the indicators used for each element.

	Element	Empirical Indicators	Year	Data Source
Framework Conditions	Formal Institutions	Local Quality of Governance Index	2018	(Tavares et al. 2018)
	Entrepreneurial Culture	Enterprises Born Rate per 1000 inhabitants (15-64 years)	2015-2018	(Statistics Portugal 2022)
		Importance to be innovative and have new ideas	2008-2018	European Social Survey (ESS)
	Networks	% of companies that cooperated with other companies or organisations	2018	Community Innovation Survey (CIS)
Systemic Conditions	Support Infrastructure	Geographical accessibility by road	2018	(Dijkstra, Poelman, and Ackermans 2019)
		Geographical accessibility by railway	2018	(Cruz et al. 2021)
		% of Population's Access to Broadband	2018	(Statistics Portugal 2022)
	Demand	Number of inhabitants	2018	(Statistics Portugal 2022)
		Purchasing Power per capita	2017	(Statistics Portugal 2022)
	Leadership	Number of H2020 Coordinators per 1000 inhabitants (15-64 years)	2014-2018	CORDIS Database
	Finance	Number of Investors per 1000 inhabitants (15-64 years)	2021	Crunchbase
		Investment in Innovation Projects per capita (15-64 years)	2010-2018	Portuguese National Innovation Agency (ANI)
		Public Investment through European Funds in Entrepreneurship and Innovation (per capita)	2010-2018	Portugal 2020
	Talent	% of higher-educated in adult population	2021	(Statistics Portugal 2022)
	Knowledge	Share of research and development (R&D) expenditure in GDP	2018	(Statistics Portugal 2022)
	Support Services	Number of Technological Infrastructures per 1000 inhabitants (15-64 years)	2018	Portuguese National Innovation Agency (ANI)
		% Support Services Firms on total business	2018	(Statistics Portugal 2022)
Outputs	Productive Entrepreneurship	Crunchbase firms per 1000 inhabitants (15-64 years)	2017-2018	Crunchbase
		Number of New Medium and High Technology Firms per 1000 inhabitants (15-64 years)	2019	(Statistics Portugal 2022)
		Number of High-growth enterprises per 1000 inhabitants (15-64 years)	2018	(Eurostat 2022)
		Firms Survival Rate (2 years)	2019	(Statistics Portugal 2022)
Outcomes	Local Social and Economic Development	Population Change	2011-2021	(Statistics Portugal 2022)
		GDP per capita	2019	(Statistics Portugal 2022)
		Territorial Quality of Life Index	2018	(Sessa et al. 2020)
		Unemployment rate change during the first year of the pandemic	2019-2020	(IEFP 2022)
		GDP per capita change during the first year of the pandemic	2019-2020	(Statistics Portugal 2022)
Control Variable	Degree of Urbanisation	Percentage of Cities, Towns and Suburb Areas in the region	2021	(Eurostat 2022)

Source: Own.

2.4. Index Construction

Building a composite index is a multifaceted endeavour that involves various stages, including theory selection, indicator identification, normalization, weighting, and aggregation procedures (OECD 2008).

In this study, the EE index was developed based on the ten elements proposed in the theoretical framework (Figure 1) and employing the Penalty for Bottleneck (PFB) methodology proposed by Acs, Rappai, and Szerb 2011. The PFB approach assumes that the performance of the ecosystem depends on the weakest element (bottleneck), that is, the bottleneck has a negative effect on the other elements, and hence on the whole ecosystem. Therefore, targeting and improving the weakest element through tailor-made policies has a magnifying effect on the overall index. This methodology differs from the most commonly applied methods of index construction, e.g. arithmetic average or sum, which assume perfect substitutability of the elements, potentially leading to misinterpretations and implications (Acs, Rappai, and Szerb 2011).

The first step involved normalizing the indicators since those were initially expressed in different statistical units. Normalization is necessary to ensure comparability among indicators and is a prerequisite for data aggregation (Mazziotta and Pareto 2013). A Min-Max normalization was used, following the equation (1):

$$0 \leq z_{re} = \left(\frac{x_{re} - x_{min,e}}{x_{max,e} - x_{min,e}}\right) \leq 1 \qquad (1)$$

where r = 1, 2, … 25 (number of sub-regions)

z_{re} is the normalized value for a particular element (e) for a sub-region (r)

x_{re} is the observed value of a particular element (e) for a sub-region (r)

$x_{min,e}$ is the minimum value of a particular element (e)

$x_{max,e}$ is the maximum value of a particular element (e)

The second step involved calculating the PFB-adjusted values for each sub-region. The values for each element were determined using equation (2) proposed by Acs, Rappai, and Szerb (2011):

$$z_{re}^{(p)} = z_{min,r} + \ln\,(1 + z_{re} - z_{min,r}) \qquad (2)$$

$z_{re}^{(p)}$ is the PFB-adjusted value for a particular element (e) for a sub-region (r)

z_{re} is the normalized value for a particular element (e) for a sub-region (r)

$Z_{min,\,r}$ is the value of lowest element for a particular sub-region (r)

The final step involved calculating the EE index with the PFB-adjusted values. A simple arithmetic average was used to aggregate the ten elements. Equal weighting was applied to each dimension, indicating that all ten elements were considered equally important and received the same weight in the final index. This procedure is widely used in composite indicators when there is limited knowledge about the strength and nature of relationships among the dimensions of the conceptual framework (OECD 2008). Moreover, other authors also applied this procedure when measuring EEs at the regional or local level (Stam and van de Ven 2021; Leendertse, Schrijvers, and Stam 2021). The resulting values were rescaled to a 0-100 scale by multiplying the index by 100 for easier visualization of the results.

To ensure the reliability of the computed index, several robustness and sensitivity tests were conducted. These tests included applying different normalization methods (log normalization, z-score normalization), employing different aggregation methods (additive, multiplicative, and logarithm), and conducting variable removal tests by calculating the index with only nine dimensions using a one-at-a-time variable removal methodology. The data analysis was performed using SPSS Statistics software and R Programming software to carry out the necessary computations.

3. RESULTS AND DISCUSSION

3.1. Descriptive Statistics

Table 2 presents the normalized means, minimum and maximum values, and standard deviations of the ten EE elements, the overall EE Index calculated according to the PFB methodology, along with its outputs and outcomes across the 25 Portuguese sub-regions. The EE Index is later discussed in the next section.

Even in a small country like Portugal, there is a significant variation in the values of the EE elements, as well in most of the outputs and outcomes. This regional heterogeneity confirms the need to analyse EEs at the local level, in order to understand better their dynamics and to design more effective policies.

Table 2 - Descriptive Statistics (EE elements after normalization)..

	N	Minimum	Maximum	Mean	Std. Deviation
Formal Institutions	25	0	.698	.510	.165
Entrepreneurial Culture	25	.304	.627	.430	.097
Networks	25	0	.852	.206	.206
Physical Infrastructure	25	.093	.779	.180	.180
Demand	25	.001	.852	.168	.168
Leadership	25	0	.825	.221	.221
Finance	25	.026	.638	.158	.158
Talent	25	0	.852	.178	.178
Knowledge	25	0	.825	.237	.237
Support Services	25	.130	.702	.141	.141
EE Index	25	20.57	72.88	40.08	13.43
CB	25	0	.292	.048	.060
MHTECH	25	.193	1.31	.437	.233
HGROW	25	.332	1.59	.841	.336
SURV	25	.438	.602	.525	.040
POP	25	-.115	.037	-.050	.043
GDP	25	14468	29291	20157.84	3082.56
QOL	25	.364	.557	.456	.048
RES_1	25	-.036	.608	.212	.152
RES_2	25	-.191	-.015	-.062	.040

Source: Own

3.2. Elements Correlation and Reliability

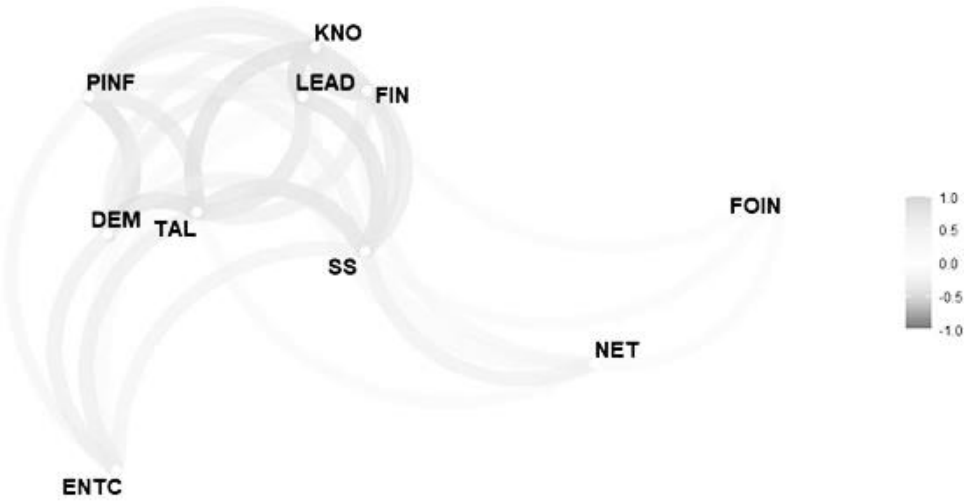
Figure 2 shows the correlation network between the ten elements, with a minimum correlation of .30. The figure shows that the seven systemic conditions are highly correlated with each other

and most often correlated to other elements. This confirms the systemic nature of EE where the elements are mutually interdependent and co-evolve (Stam and van de Ven 2021). On the other hand, the framework conditions (formal institutions, entrepreneurial culture and networks) are poorly correlated with each other and with the other elements. This may be explained by the nature of the indicators which may not capture these dimensions at sub-regional. In the case of Formal Institutions, it is not significantly correlated with any other element. The nature of the local/regional formal institutions in Portugal may explain this result, since Portugal does not have regional or sub-regional government bodies, and the indicator used was a quality of government index made to Local Administrative Units (Municipalities). Besides, this was also reported in other studies where *Formal Institutions* or *Entrepreneurial Culture* were poorly or negatively connected to the other EE elements (Stam and van de Ven 2021).

To build the EE index, we not only perform the correlation analysis but also a principal component analysis (PCA) to uncover the dimensions underlying the ten elements. The PCA highlighted two dimensions, one covering all the systemic conditions and another covering the three framework conditions. Besides, a reliability analysis performed on the ten elements showed strong scale reliability with a Cronbach's Alpha higher than 0.895.

Despite some issues regarding the framework conditions, given the higher correlations among the systemic conditions and higher scale reliability, the systemic nature of the EE is verified and the construction of a compositive index is possible to better analyse and discuss the EE in each region.

Figure 2 – Correlation Network of the EE elements (2018). Minimum Correlation = .30.



Source: Authors using R Programming software.

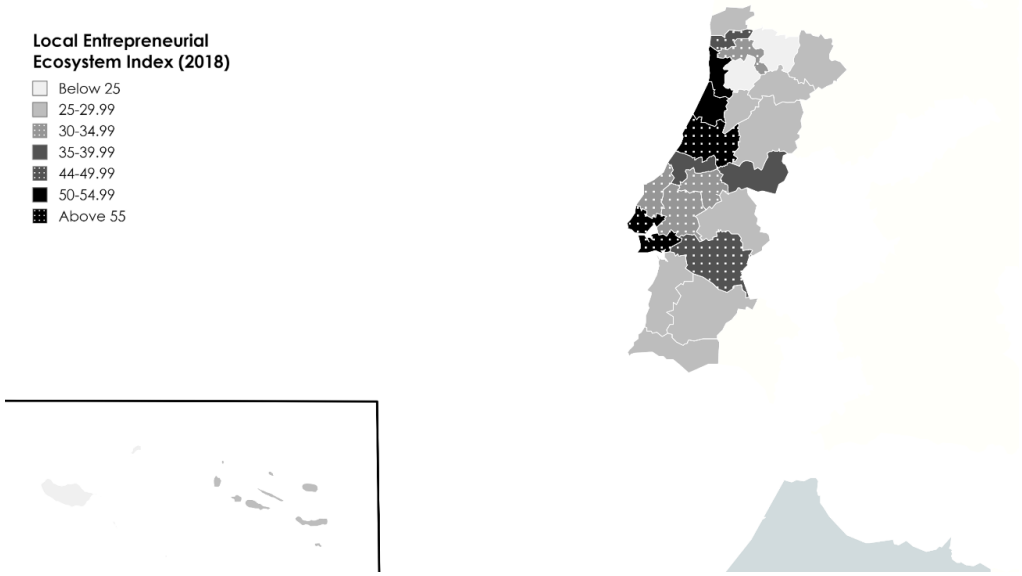
3.3 The Local Entrepreneurial Ecosystem Index in Portugal

The EE index was constructed according to the procedures described in the methodology section, using a Min-Max normalisation of the indicators, and a Penalty for Bottleneck aggregation procedure. Besides, several robustness tests were conducted. These tests did not substantially change the ranking order of the NUTS-3 regions, especially regarding the top and bottom regions which remain the same (see the Supplementary Material provided by the authors).

The geographical pattern of the EE index by sub-region is shown in Figure 3, with a distribution divided into seven categories. The darker areas, associated with above-average values of the index, are mainly located in the coastal areas of Portugal. The lighter areas, associated with lower values of the index are mainly located in the inland areas of Portugal and on the islands, following other studies on entrepreneurship in Portugal (da Silva and Teixeira 2012; Tibério and Teixeira 2018). The map also confirms the high intra-region variability of the local EE index. A clear case

is the Norte Region (NUTS-2), which encompasses two sub-regions with the highest EE scores (AM Porto and Cávado) and two of the lowest EE scores (Alto-Tâmega and Tâmega e Sousa). This supports the importance of analysing EEs at a more disaggregated territorial level (Iacobucci and Perugini 2021).

Figure 3 - Local Entrepreneurial Index of Portuguese NUTS-3 Regions (2018).



Source: Authors.

3.4 Urban-Rural Comparison

In comparing the EE index across different types of regions, we introduced the Degree of Urbanisation as a control variable. Our analysis revealed a clear pattern: regions with a higher percentage of urban areas exhibited higher EE Index values. This indicates that cities and intermediate regions generally possess stronger EEs, while rural and remote regions tend to have weaker ecosystems, particularly in terms of support infrastructure, demand, and availability of talent.

These rural-urban disparities regarding EE quality and its elements align with findings from prior research (Liedtke, Asghari, and Spengler 2021). These differences can be attributed to various factors, such as the agglomeration effects in urban areas, with a higher concentration of businesses, networks, and resources that foster entrepreneurship. On the other hand, rural areas face unique challenges, such as limited access to resources, a smaller customer base, and reduced connectivity. It is important to note that there are exceptions among rural areas that host regional capitals or significant higher education institutions, such as Alentejo Central with the University of Évora, following recent studies which argue the important role of higher education institutions in rural EE (Asmit et al. 2024; Lyons, Miller, and Mann 2017).

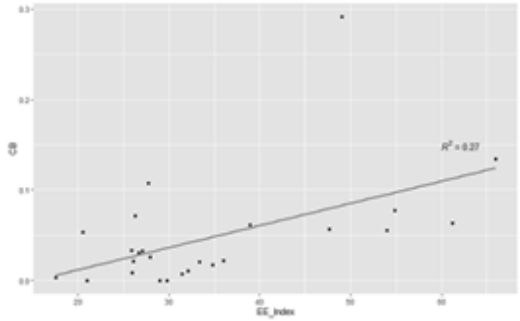
Efforts to bridge the urban-rural divide should focus on leveraging the specific strengths of rural areas, such as their natural resources, cultural heritage, and local networks (Almeida and Daniel 2022). By nurturing entrepreneurship in both urban and rural contexts, policymakers can foster balanced regional development and unlock the full potential of their respective EEs.

3.5 EE Index, Outputs and Outcomes

When exploring the correlations between the EE index and the output and outcome indicators, we observed several noteworthy relationships. The EE index is positively correlated with two outputs, the number of Crunchbase firms and medium-high technology firms, and two outcomes, population change and GDP per capita. Conversely, it is negatively correlated with firm survival rate, a finding that requires further clarification.

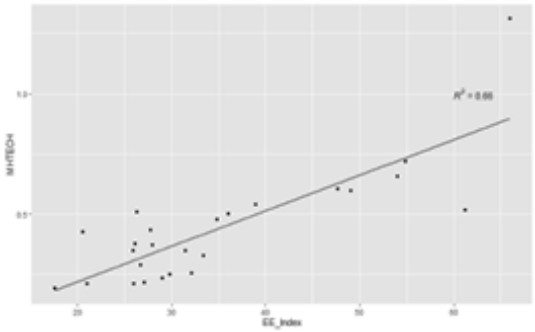
To further explore the relations, several linear regression analyses between the EE index (and its framework and systemic conditions) as independent variables, the outputs and the outcomes, as dependent variables, were performed (Table 3). Regarding the entrepreneurship outputs, the EE index positively explains the number of Crunchbase Firms and Medium-High Technology Firms. Figures 4 and 5 show the scatterplot and the linear relation between the EE index and Crunchbase firms (Figure 4) and Medium-High Technology Firms (Figure 5). This linear model has an R^2= .27 for Crunchbase firms and R^2= .66 for Medium-High Technology Firms, highlighting the causation effect of the elements of the LEE (combined) on productive entrepreneurial activity within a given territory, aligning with previous studies (Stam and van de Ven 2021).

Figure 4 - Regression analysis between EE Index and Crunchbase Firms



Source: Authors using R programming software.

Figure 5 - Regression analysis between EE Index and Medium-High Technology Firms.



Source: Authors using R programming software.

Regarding local social-economic development, the EE index exhibited significant associations with two indicators: Population Change and GDP per capita. In this case, a strong EE can provide individuals with the support and resources necessary to start and grow successful businesses, which can create job opportunities and attract more talented individuals to the region.

However, the EE quality did not show a correlation with the overall quality of life index (QoL), which aligns with findings from other studies. For example, Penco, Ivaldi, and Ciacci (2021) found a positive correlation between EE strength and subjective well-being, primarily in large cities, which did not include any Portuguese cities. Additionally, we assessed the individual dimensions of the QoL index and found that the EE index exhibited positive correlations with socioeconomic enablers and economic and social health dimensions. Conversely, it displayed a negative correlation with the ecological health dimension. Similar patterns have been observed in other studies, where the EE index demonstrated stronger correlations with economic well-being dimensions (Penco, Ivaldi, and Ciacci 2021).

Regarding the resistance to the pandemic crisis, we found that although systemic conditions may explain variations in the unemployment rate, the overall EE index did not exhibit correlations with the two indicators used to measure local resistance during the first year of the COVID-19 pandemic. These findings challenge other studies that have reported a positive and significant effect of EE quality on resilience during crises (Iacobucci and Perugini 2021). However, this observation can be explained by the unique nature of the social and economic crisis caused by the pandemic. It is worth noting that the rural regions, which generally have lower EE indexes in

Portugal, experienced an influx of people during the pandemic due to their lower population density. Consequently, the lockdown measures had a relatively lower impact on these local economies, with many even experiencing growth during the pandemic (Almeida and Daniel 2022).

Table 3 – Regression Analyses between EE index, outputs and outcomes.

Independent Variable	Dependent Variable	R^2	β	*F*	*p*	DW
EE Index	Crunchbase Firms	.273	.523	8.66	.007	1.75
	Medium-High Technology Firms	.662	.813	44.97	<.001	1.60
	High-Growth Firms		.310	2.44	.132	2.24
	Survival Rate	.187	-.432	5.28	.031	1.12
	Population Change	.176	.420	4.92	.037	2.03
	GDP	.415	.664	16.32	<.001	1.23
	Quality of Life		.085	.168	.685	.796
	RES_1		.253	1.58	.222	2.54
	RES_2		.121	.340	.565	1.49

Source: Authors using SPSS software.

3.6 Local Bottlenecks and Regional Priorities

The methodology employed in this study assumes that bottleneck elements have adverse effects on other EE components. Thus, identifying and addressing these bottlenecks is crucial for formulating effective policies that enhance the overall quality of the LEE.

Table 4 provides an overview of the local bottlenecks which are identified as the first and second elements with the lowest scores, for each sub-region. The most frequently observed bottlenecks are 'leadership' (14/25 sub-regions) and 'demand' (5/25 sub-regions). When considering the first and second bottlenecks combined, 'leadership' remains the primary bottleneck in 16/25 sub-regions, followed by 'demand' (13/25), 'finance' (7/25) and 'knowledge' (6/25).

Additionally, Table 4 also presents the regional priorities based on the most common bottlenecks in each NUTS 2 region. In cases where the NUTS 2 and NUTS 3 sub-regions coincide (*AM Lisboa, Algarve, RA Madeira and RA Açores*), the identified bottlenecks are the same. For the *Norte* region, the regional priorities should focus on 'leadership' and 'finance'. In the *Centro* region, attention should be given to enhancing 'leadership' and addressing 'demand'. Lastly, the *Alentejo* region should prioritize improving the available 'demand' and 'finance' within the regional ecosystem.

Portugal's cultural and educational context may influence the lack of leadership. Entrepreneurship might not be widely promoted or encouraged in the country's educational system, leading to a limited pool of individuals with the necessary leadership skills and entrepreneurial mindset (Banha et al. 2017). On the other hand, the lack of demand may be influenced by Portuguese market characteristics and economic conditions. Portugal's market dynamics, including limited market size, low consumer purchasing power, or specific sectorial limitations, may create challenges for entrepreneurs in generating demand for their products or services. Finally, limited access to financial resources, such as venture capital, angel investment, or traditional funding options, can hamper entrepreneurial activities and restrict new ventures' growth potential (Banha et al. 2017).

These bottlenecks can be targeted through various policy actions, such as identifying and empowering individuals or organizations capable of assuming leadership roles, digitalizing local businesses to stimulate market demand (Xu and Dobson 2019), or promoting alternative funding sources such as angel investors, crowdfunding, peer-to-peer lending, and impact investors (Bruton et al. 2015). Additionally, long-term policies and coordinated efforts from local and regional governance are essential to sustaining and further developing the entrepreneurial ecosystems in the respective sub-regions (Almeida and Daniel, 2023).

Table 4 - Local Bottlenecks and Regional Priorities.

Region (NUTS 2)	Sub-Region (NUTS 3)	Typology	Rank	LEE Index	Local Bottleneck	2nd Local Bottleneck	Regional Priorities
Norte	Alto Minho	Predominantly Rural	20	26.10	Leadership	Demand	Leadership/Finance
	Cávado	Intermediate	6	47.63	Demand	Finance	
	Ave	Intermediate	11	32.12	Leadership	Demand	
	Área Metropolitana do Porto	Predominantly Urban	3	54.89	Leadership	Formal Institutions	
	Alto Tâmega	Predominantly Rural	23	21.02	Leadership	Demand	
	Tâmega e Sousa	Intermediate	25	17.52	Talent	Knowledge	
	Douro	Predominantly Rural	21	25.95	Demand	Finance	
	Terras de Trás-os-Montes	Predominantly Rural	17	27.09	Leadership	Finance	
Centro	Oeste	Predominantly Rural	9	34.81	Leadership	Finance	Leadership/Demand
	Região de Aveiro	Intermediate	4	54.01	Demand	Entrepreneurial Culture	
	Região de Coimbra	Predominantly Rural	2	61.19	Demand	Finance	
	Região de Leiria	Predominantly Urban	7	38.92	Leadership	Demand	
	Viseu Dão Lafões	Predominantly Rural	15	27.91	Leadership	Demand	
	Beira Baixa	Rural	8	36.03	Leadership	Demand	
	Médio Tejo	Predominantly Rural	12	31.45	Leadership	Knowledge	
	Beiras e Serra da Estrela	Rural	16	27.71	Leadership	Demand	
AM Lisboa	Área Metropolitana de Lisboa	Predominantly Urban	1	65.96	Finance	Leadership	Finance
Alentejo	Alentejo Litoral	Predominantly Rural	22	25.87	Knowledge	Leadership	Demand/Finance
	Baixo Alentejo	Rural	14	28.96	Finance	Demand	
	Lezíria do Tejo	Predominantly Rural	10	33.34	Leadership	Knowledge	
	Alto Alentejo	Rural	13	29.77	Leadership	Finance	
	Alentejo Central	Rural	5	49.02	Demand	Talent	
Algarve	Algarve	Intermediate	19	26.25	Networks	Knowledge	Networks
RA Açores	Região Autónoma dos Açores	Outermost Region	18	26.70	Leadership	Knowledge	Leadership
RA Madeira	Região Autónoma da Madeira	Outermost Region	24	20.52	Formal Institutions	Finance	Formal Institutions

Source: Own.

CONCLUDING REMARKS

Entrepreneurship has long been recognized as a significant driver of local development, playing a crucial role in creating jobs, increasing productivity, promoting innovation, and stimulating economic growth (Vázquez-Barquero and Rodríguez-Cohard 2019). Notwithstanding, fostering entrepreneurship requires a supportive environment to innovate and develop new businesses (Cowell, Lyon-Hill, and Tate 2018). This study provides valuable insights into the nature and dynamics of EEs at the local level in Portugal and their implications for local economic and social development.

The findings reveal the existence of diverse EEs within each Portuguese region, emphasizing the importance of analysing EEs at the local level. This underscores the limitations of existing studies that primarily focus on national or regional levels, overlooking the unique characteristics and developmental stages of local EEs. Secondly, a clear division between urban and rural EEs is observed in Portugal, particularly in terms of demand, support infrastructure, and talent availability, with exceptions made for places that are regional capitals or possess universities. This highlights the need for tailored strategies that address the specific needs and challenges faced by different types of EEs in various geographical contexts.

Furthermore, the study establishes a positive relationship between the quality of the Local Entrepreneurial Ecosystem (LEE) and entrepreneurship outputs, such as the number of Crunchbase firms and medium-high tech firms. While systemic conditions contribute to the growth of high-growth firms, the study suggests that framework conditions, including culture, networks, and formal institutions, may have hindering effects on entrepreneurship outputs. On the other hand, we should highlight the negative relationship between EE index and the business survival rate, arguing that policymakers should consider these dynamics and implement policies that support both the establishment and sustainability of new ventures within the LEE.

Regarding outcomes, a strong LEE has the potential to attract and retain talented individuals, which can influence population change. Additionally, the quality of the LEE is positively associated with regional GDP, emphasizing the role of entrepreneurship in driving economic prosperity. However, no significant correlation is found between LEE quality, quality of life, and resistance to crises within a region. This indicates the need for a more comprehensive understanding of the multifaceted impacts of EEs on regional well-being and resilience.

Lastly, this study identifies leadership, demand, and finance as the critical dimensions of the EE that require attention from local and regional policymakers. Addressing these bottlenecks through targeted policies and initiatives, such as empowering local actors, stimulating market demand, and diversifying funding sources, can enhance the overall quality of the LEEs and contribute to fostering a thriving entrepreneurial environment.

Overall, this study contributes to the growing body of research on EEs by confirming the systemic nature of EEs and the positive relationship between LEEs and entrepreneurship outputs and outcomes, emphasizing the significance of ongoing research into the nature and dynamics of EEs, particularly at the local level, to enhance our understanding of their implications for entrepreneurship and regional economic development.

Implications for Policy-Making

The findings of this study hold significant implications for policymaking. Our research underscores the importance of cultivating an ecosystem that facilitates entrepreneurship and innovation as a means of promoting sustainable social and economic development within a given territory. The local and regional bottlenecks identified should be targeted by policymakers to improve the quality of the LEEs. By tackling these bottlenecks, policymakers can actively create a supportive environment for entrepreneurs and promote the growth of new firms. This needs a nuanced understanding of the local ecosystem and tailoring policy interventions to suit the unique conditions of each region.

Furthermore, empowering local actors and decentralizing competencies can enhance the capacity of local and regional policymakers to implement effective strategies for promoting EEs as drivers of local development. By engaging and collaborating with local stakeholders, policymakers can leverage their expertise and insights to design policies that align with the specific needs and opportunities within the LEE.

Limitations and Further Research

Our study acknowledges certain methodological challenges that should be considered. While the use of equal weighting in index construction is common practice, it may introduce limitations as different EE elements may have varying degrees of importance (Corrente et al. 2019). On the other hand, while the PFB methodology used in this study helped to reduce some of the compensability issues in the aggregation procedure, further research should explore alternative weighting and aggregation procedures to enhance the accuracy of the LEE index. In addition, due to the unavailability of longitudinal data, this study did not account for the backward causation effects, where prior entrepreneurial activities feedback into EE elements (Stam and van de Ven 2021). Further research should investigate this causation effect to gain a better understanding of the evolution of the LEE over time.

Although our analysis indicated that sub-regions in proximity to high-performing areas tend to exhibit better performance, this relationship was not empirically tested. Thus, future studies should explore the effects of high-performing LEEs on neighbouring sub-regions. Additionally, one pertinent question is raised through our findings related to the interaction between LEEs and other ecosystems, such as regional or national ecosystems, and their reciprocal influences. Examining the interdependencies and synergies between different ecosystems can provide a comprehensive understanding of their collective impact on entrepreneurship and regional economic development.

Another crucial area of research pertains to understanding why rural regions exhibit lower LEE quality compared to urban areas. This raises two important questions: Are EEs predominantly urban phenomena, with entrepreneurship struggling to thrive in rural areas? Or do the frameworks and measurement tools used for EEs have an inherent bias toward urban contexts?

Finally, future research should strive to enhance EE empirical analyses by conducting cross-country comparisons and incorporating additional relevant indicators at the country level. This would provide a broader perspective on the similarities and differences in EEs across various contexts, enriching our understanding of the factors influencing EEs from a local to a global scale.

REFERENCES

Acs, Zoltan J., Gábor Rappai, and László Szerb. 2011. "Index-Building in a System of Interdependent Variables: The Penalty for Bottleneck." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1945346.

Almeida, J., & Daniel, A. (2023). Local governance of evolutionary entrepreneurial ecosystems: A case study in a low-density territory. Local Economy, 38(8), 735-754. https://doi.org/10.1177/0269094224127863

Almeida, João, Ana Daniel, and Anabela Botelho. 2023. "Local Development Through Entrepreneurship and Innovation Ecosystems." In *Territorial Innovation in Less Developed Regions*, edited by Filipe Teles, Carlos Rodrigues, Fernando Ramos, and Anabela Botelho, 245–66. Springer.

Almeida, João, and Ana Dias Daniel. 2022. "Post-Pandemic Opportunities for Low-Density Territories: Insights and Implications from Portuguese Case Studies." *European Planning Studies*, May, 1–24.

Alvedalen, Janna, and Ron Boschma. 2017. "A Critical Review of Entrepreneurial Ecosystems Research: Towards a Future Research Agenda." *European Planning Studies* 25 (6): 887–903.

Asmit, Brilliant, Togar Mangihut Simatupang, Bambang Rudito, and Santi Novani. 2024. "Uncovering the Building Blocks of Rural Entrepreneurship: A Comprehensive Framework for Mapping the Components of Rural Entrepreneurial Ecosystems." *Heliyon* 10 (1): e24139.

Banha, Francisco Manuel, Maria Helena Almeida, Efigenio Luz Rebelo, and Alejandro Orgambídez Ramos. 2017. "The Main Barriers of Portuguese Entrepreneurship Ecosystem: Interpretive Structural Modeling (ISM) Approach." *Tourism & Management Studies* 13 (2): 60–70.

Bruton, Garry, Susanna Khavul, Donald Siegel, and Mike Wright. 2015. "New Financial Alternatives in Seeding Entrepreneurship: Microfinance, Crowdfunding, and Peer–to–Peer Innovations." *Entrepreneurship Theory and Practice* 39 (1): 9–26.

Corrente, Salvatore, Salvatore Greco, Melita Nicotra, Marco Romano, and Carmela Elita Schillaci. 2019. "Evaluating and Comparing Entrepreneurial Ecosystems Using SMAA and SMAA-S." *The Journal of Technology Transfer* 44: 485–519.

Cowell, Margaret, Sarah Lyon-Hill, and Scott Tate. 2018. "It Takes All Kinds: Understanding Diverse Entrepreneurial Ecosystems." *Journal of Enterprising Communities: People and Places in the Global Economy* 12 (2): 178–98.

Credit, Kevin, Elizabeth A. Mack, and Heike Mayer. 2018. "State of the Field: Data and Metrics for Geographic Analyses of Entrepreneurial Ecosystems." *Geography Compass* 12 (9): e12380.

Cruz, Carlos Oliveira, Álvaro Costa, Joaquim Miranda Sarmento, Sousa Vítor, and João Januário. 2021. "Sistemas de Transportes Em Portugal: Análise de Eficiência e Impacto Regional." Fundação Francisco Manuel dos Santos. https://www.ffms.pt/FileDownload/63193dfa-4587-4321-8eb7-56d6b08897b9/resumo-do-estudo-sistemas-de-transportes-em-portugal.

Dijkstra, Lewis, Hugo Poelman, and Linde Ackermans. 2019. "Road Transport Performance in Europe: Introducing a New Accessibility Framework." European Commission. https://ec.europa.eu/regional_policy/sources/docgener/work/2019_02_road_transport.pdf.

European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs. 2021. "Regional Innovation Scoreboard 2021." Publications Office. https://data.europa.eu/doi/10.2873/674111.

Eurostat. 2022. "Eurostat - Database." 2022. https://ec.europa.eu/eurostat/web/main/data/database.

Freitas, Carmen, and Michael Kitson. 2018. "Perceptions of Entrepreneurial Ecosystems in Remote Islands and Core Regions." *Island Studies Journal* 13 (1): 267–84.

GEM. 2019. "GEM - Portugal Economy Profile." Global Entrepreneurship Monitor. 2019. https://www.gemconsortium.org/economy-profiles/portugal-2.

Iacobucci, Donato, and Francesco Perugini. 2021. "Entrepreneurial Ecosystems and Economic Resilience at Local Level." *Entrepreneurship and Regional Development* 33 (9–10): 689–716.

IEFP. 2022. "Portuguese National Employment Institute (IEFP) - Statistics." 2022. https://www.iefp.pt/estatisticas.

Isenberg, Daniel J. 2010. "How to Start an Entrepreneurial Revolution." *Harvard Business Review*. https://institute.coop/sites/default/files/resources/Isenberg%20-%20How%20to%20Start%20an%20Entrepreneurial%20Revolution.pdf.

Kansheba, Jonathan Mukiza, and Andreas Erich Wald. 2020. "Entrepreneurial Ecosystems: A Systematic Literature Review and Research Agenda." *Journal of Small Business and Enterprise Development* 27 (6): 943–64.

Leendertse, J., M. Schrijvers, and E. Stam. 2021. "Measure Twice, Cut Once: Entrepreneurial Ecosystem Metrics." *Research Policy*. https://doi.org/10.1016/j.respol.2021.104336.

León, L., K. Izsak, P. Markianidou, K. Bougas, Technopolis Group, and A. Alonso. 2017. "Regional Ecosystem Scoreboard Updated Methodology Report." European Cluster Observatory.

Liedtke, Matthias, Reza Asghari, and Thomas Spengler. 2021. "Fostering Entrepreneurial Ecosystems and the Choice of Location for New Companies in Rural Areas – the Case of Germany." *Journal of Small Business Strategy* 31 (4): 76–87.

Liguori, Eric, Josh Bendickson, Shelby Solomon, and William C. McDowell. 2019. "Development of a Multi-Dimensional Measure for Assessing Entrepreneurial Ecosystems." *Entrepreneurship and Regional Development* 31 (1–2): 7–21.

Lyons, Thomas S., Steven R. Miller, and John T. Mann. 2017. "A New Role for Land Grant Universities in the Rural Innovation Ecosystem?" *Journal of Regional Analysis Policy* 48 (2): 32–47.

Mason, Colin, and Ross Brown. 2014. "Entrepreneurial Ecosystems and Growth-Oriented Entrepreneurship." OECD Science, Technology and Industry Policy Papers. Organisation for Economic Co-Operation and Development (OECD). https://doi.org/10.1787/5k4869clw0xp-en.

Mazziotta, Matteo, and Adriano Pareto. 2013. "Methods for Constructing Composite Indices: One for All or All for One." *Rivista Italiana Di Economia, Demografia e Statistica* 67 (2): 67–80.

Mikic, Mihaela, Tin Horvatinovic, and Ivana Kovac. 2020. "Climbing up the Regional Intellectual Capital Tree: An EU Entrepreneurial Ecosystem Analysis." *Journal of Intellectual Capital* 22 (6): 1030–54.

Miles, Morgan P., and Mark Morrison. 2020. "An Effectual Leadership Perspective for Developing Rural Entrepreneurial Ecosystems." *Small Business Economics* 54 (4): 933–49.

Muñoz, Pablo, Ewald Kibler, Vesna Mandakovic, and José Ernesto Amorós. 2020. "Local Entrepreneurial Ecosystems as Configural Narratives: A New Way of Seeing and Evaluating Antecedents and Outcomes." *Research Policy*, July, 104065.

Nicotra, M., M. Romano, Manlio Del Giudice, and Carmela Elita Schillaci. 2018. "The Causal Relation between Entrepreneurial Ecosystem and Productive Entrepreneurship: A Measurement Framework." *Journal of Technology Transfer* 43: J Technol Transf.

OECD. 2008. "Handbook on Constructing Composite Indicators: Methodology and User Guide." OECD Publications: Paris, France. https://www.oecd.org/sdd/42495745.pdf.

Penco, Lara, Enrico Ivaldi, and Andrea Ciacci. 2021. "Entrepreneurial Ecosystem and Well-Being in European Smart Cities: A Comparative Perspective." *The TQM Journal* 33 (7): 318–50.

Perugini, Francesco. 2022. "Space–Time Analysis of Entrepreneurial Ecosystems." *The Journal of Technology Transfer*, January. https://doi.org/10.1007/s10961-021-09906-w.

Pita, Mariana, Joana Costa, and António Carrizo Moreira. 2021. "Entrepreneurial Ecosystems and Entrepreneurial Initiative: Building a Multi-Country Taxonomy." *Sustainability* 13 (7). https://doi.org/ https://doi.org/10.3390/su13074065.

Porras-Paez, Andrea, and Jana Schmutzler. 2019. "Orchestrating an Entrepreneurial Ecosystem in an Emerging Country: The Lead Actor's Role from a Social Capital Perspective." *Local Economy* 34 (8): 767–86.

Radosevic, Slavo, and Esin Yoruk. 2013. "Entrepreneurial Propensity of Innovation Systems: Theory, Methodology and Evidence." *Research Policy* 42 (5): 1015–38.

Sessa, C., G. Galvini, O. Biosca, H. Castillho, A. UIlied, H. Tödtling-Schönhofer, J. Haider, et al. 2020. "ESPON QoL – Quality of Life Measurements and Methodology." ESPON EGTC. https://www.espon.eu/sites/default/files/attachments/ESPON%20QoL%20-%20Final%20Report%20-%2001292021-FINAL.pdf.

Silva, Carina Ribeiro da, and Aurora Amélia Castro Teixeira. 2012. "Mapeamento do Empreendedorismo do Poder Local em Portugal." *RPER*, no. 31 (October): 55–70.

Singh, A. K., and S. N. Ashraf. 2020. "Association of Entrepreneurship Ecosystem with Economic Growth in Selected Countries: An Empirical Exploration." *Journal of Entrepreneurship, Business and Economics* 8 (2): 36–92.

Spigel, Ben, Fumi Kitagawa, and Colin Mason. 2020. "A Manifesto for Researching Entrepreneurial Ecosystems." *Local Economy* 35 (5): 482–95.

Stam, Erik. 2015. "Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique." *European Planning Studies* 23 (9): 1759–69.

Stam, Erik, and Andrew van de Ven. 2021. "Entrepreneurial Ecosystem Elements." *Small Business Economics* 56 (2): 809–32.

Statistics Portugal. 2022. "Statistics Portugal - Web Portal." 2022. https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE&xlang=en.

Sternberg, Rolf, Johannes von Bloh, and Alicia Coduras. 2019. "A New Framework to Measure Entrepreneurial Ecosystems at the Regional Level." *Zeitschrift Für Wirtschaftsgeographie* 63 (2–4): 103–17.

Subtil, Inês, Patrícia Palma, Sónia Gonçalves, and Maria Velez. 2023. "O Ecossistema Empreendedor nos Municípios Portugueses: A Ação do Poder Local no Incentivo à Atividade Empreendedora." *RPER*, no. 64 (May): 47–63.

Szerb, László, Zsófia Vörös, Éva Komlósi, Zoltan J. Acs, Balázs Páger, and Gábor Rappai. 2017. "The Regional Entrepreneurship and Development Index: Structure, Data, Methodology and Policy Applications." Horizon2020 Project - FIRES. http://www.projectfires.eu/wp-content/uploads/2018/07/d4.4-the-regional-entrepreneurship-and-development-index_-structure-data-methodology-and-policy-applications.pdf.

Tavares, António F., Luís Sousa, Ana Macedo, Daniel Fernandes, Filipe Teles, Luís Mota, Nuno Cruz, and Sara Pires. 2018. "Qualidade Da Governação Local Em Portugal." Fundação Francisco Manuel dos Santos. https://play.google.com/store/books/details?id=JNnWzgEACAAJ.

Tibério, Bárbara, and Aurora Amélia Castro Teixeira. 2018. "O Lado Sombrio do Empreendedorismo: Pobreza e Empreendedorismo nos Municípios Portugueses." *RPER*, no. 48 (July): 33–53.

Vázquez-Barquero, Antonio, and Juan Carlos Rodríguez-Cohard. 2019. "Local Development in a Global World: Challenges and Opportunities." *Regional Science Policy & Practice* 11 (6): 885–97.

Wurth, Bernd, Erik Stam, and Ben Spigel. 2021. "Toward an Entrepreneurial Ecosystem Research Program." *Entrepreneurship Theory and Practice*, March, 1042258721998948.

Xu, Zimu, and Stephen Dobson. 2019. "Challenges of Building Entrepreneurial Ecosystems in Peripheral Places." *Journal of Entrepreneurship and Public Policy* 8 (3): 408–30.

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Convergence and Determinants of Carbon Emissions in Brazilian Agriculture

Convergência e Determinantes das Emissões de Carbono na Agricultura Brasileira

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Abstract

This paper presents empirical evidence of the convergence of carbon dioxide (CO^2) emissions from managed agricultural soils (direct emissions from agriculture) and their determinants for the Brazilian states during the period from 1975 to 2019. For this purpose, the log t-test and a clustering algorithm are used to investigate the characteristics of the convergence process of CO^2 emissions in agriculture. Subsequently, a Probit model is used to identify the factors that determine the formation of convergence clubs. Employing this econometric approach, we identify two convergence clubs. One club consists of 9 (33%) Brazilian states with high CO^2 emissions in agriculture, while the other is formed of 18 (67%) states with low emissions. Land use, labor, capital, bovine density, agricultural production, industrial production, rural credit, and energy consumption are identified as drivers for the formation of these convergence clubs. Finally, when comparing the CO^2 emissions of these clubs before and after the implementation of the Kyoto Protocol, we find that environmental sustainability has been widely neglected in Brazilian agriculture.

*Keywords***:** convergence analysis; carbon dioxide emissions; agriculture; managed soils; Brazil.

JEL Code: Q1; Q52; Q53.

Resumo

Este artigo apresenta evidências empíricas da convergência das emissões de dióxido de carbono (CO^2) de solos agrícolas manejados (emissões diretas da agricultura) e seus determinantes para os estados brasileiros durante o período de 1975 a 2019. Para isso, o teste log t e um algoritmo de agrupamento são usados para investigar as características do processo de convergência das emissões de CO^2 na agricultura. Posteriormente, um modelo Probit é usado para identificar os fatores que determinam a formação de clubes de convergência. Empregando essa abordagem econométrica, identificamos dois clubes de convergência. Um clube é formado por 9 (33%) estados brasileiros com altas emissões de CO^2 na agricultura, enquanto o outro é formado por 18 (67%) estados com baixas emissões. O uso da terra, a mão de obra, o capital, a densidade de bovinos, a produção agrícola, a produção industrial, o crédito rural e o consumo de energia são identificados como fatores determinantes para a formação desses clubes de convergência. Por fim, ao compararmos as emissões de CO^2 desses clubes antes e depois da implementação do Protocolo de Kyoto, constatamos que a sustentabilidade ambiental tem sido amplamente negligenciada na agricultura brasileira.

Palavras-chave: análise de convergência; emissões de dióxido de carbono; agricultura; solos manejados; Brasil.

Códigos JEL: Q1; Q52; Q53.

1. INTRODUCTION

Global warming is one of the most pressing environmental issues the world faces today. Greenhouse gas emissions (GHGs), largely stemming from economic globalization processes, are now more than ever recognized as a driving force behind climate change (Adebayo et al., 2021; Li et al., 2020). This recognition has led both developed and emerging countries to commit to reducing GHG emissions and to develop policies to address climate challenges at the international level (Panopoulou and Pantelidis, 2009). In recent times, countries have taken various commitments to reduce environmental degradation, mainly through medium and long-term carbon emission reduction targets. One of the initiatives that highlights these efforts is the Kyoto Protocol (1997), which came into effect in 2005 (Payne, 2020). Although countries are more concerned about environmental issues in this century, carbon dioxide (CO^2) emissions, one of the main causes of global warming, already exceed 41 billion tons emitted annually (Ivanovski and Churchill, 2020).

Among economic sectors, it is estimated that agriculture is responsible for approximately 10% of global CO^2 emissions. In recent decades, agricultural emissions have been growing at an average rate of 0.5% per year worldwide.[1] These carbon emissions are expected to continue growing in the coming decades, as this sector is one of the drivers of economic growth and exports in developing countries (Martinelli et al., 2010). These substantial levels of carbon emissions associated with agriculture have spurred a growing body of literature dedicated to exploring the environmental impacts of the development of this economic activity (see, for example, Raihan et al. (2022), Ridzuan et al. (2020), Prastiyo et al. (2020), Balsalobre-Lorente et al. (2019), and Appiah et al. (2018)). Previously, other studies have focused on analyzing the impact of economic growth (Khan et al. (2020), Ito (2017), and Aye and Edoja (2017)), energy consumption (Khan et al. (2019), Paramati et al. (2017), and Kais and Sami (2016)), trade (Mahmood et al. (2019) and Meng et al. (2018)), financial development (Khan and Ozturk (2021) and Salahuddin et al. (2018)), research and development (Churchill et al. (2019) and Fernández et al. (2018)), among other factors that may influence carbon emissions (see Shahbaz and Sinha (2019) for a comprehensive review).

In the wake of the literature examining the determinants of environmental degradation, investigations focusing on the spatial distribution of GHG emissions have emerged (Ivanovski and Churchill, 2020). Supported by the theoretical framework developed by Brock and Taylor (2010), which incorporates pollution flows into Solow's (1956; 1957) economic growth model to provide a reasonable economic explanation for the Environmental Kuznets Curve (EKC) (Grossman and Krueger, 1995), a branch of this area of research is increasingly examining environmental convergence (Pettersson et al., 2014). The main direction of this branch has been convergence in GHG emissions levels, with CO^2 emissions being the most analyzed (Payne, 2020). In particular, the non-stationary properties of these emissions with respect to a common trajectory are examined (Lee et al. (2023), Zhu and Lin (2020), Ivanovski and Churchill (2020), Yu et al. (2018), Runar et al. (2017), Apergis and Payne (2017), Wu et al. (2016), Burnett (2016), Zhao et al. (2015), and Panopoulou and Pantelidis (2009)). These studies are recognized for playing an important role in the deliberate learning of comprehensive and targeted strategies to reduce greenhouse gas emissions in different sectors and spatial scales (Ivanovski and Churchill, 2020).

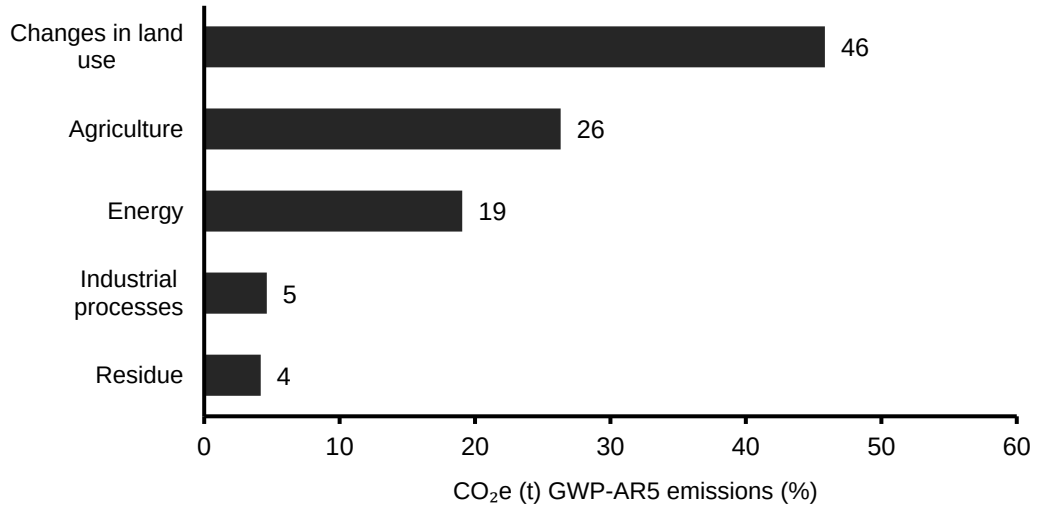
To contribute to these two fields of environmental economic literature, we base our analysis on the economic model proposed by Brock and Taylor (2010), which allows for the prediction of emissions convergence among economies at different stages of development. This prediction is substantiated by the EKC hypothesis, which posits an inverted U-shaped relationship between environmental pollution and economic development (Sarkodie and Strezov, 2019). Environmental convergence (i.e., convergence in emissions) can be understood as a phenomenon in which economies with higher carbon emissions tend to converge toward lower emission levels as they reach higher levels of development (Lawson et al., 2020). As highlighted by Ivanovski and Churchill (2020) and

[1] Information obtained from Our World in Data (September 24, 2023).

Ivanovski et al. (2018), there are still few studies that use disaggregated longitudinal data on carbon emissions and address the heterogeneity of states within countries, i.e., that control the economic characteristics of regions, such as capital, technology, infrastructure, economic resources, and institutional quality.

Considering this context, this paper presents empirical evidence on the convergence of carbon dioxide (CO^2) emissions in the agricultural sector related to soil management (direct emissions from agriculture) and its determinants for the states of Brazil during the period from 1975 to 2019. Brazil offers an attractive scenario for at least two reasons. First, Brazilian agricultural production totaled US$ 88.2 billion in 2019, making the country one of the top five food producers in the world.[2] Second, the country is among the nations that contribute the most to global warming (Adebayo et al., 2021). Annually, the Brazilian economy emits more than 2,148 million tons of CO^2 equivalent (CO^2e) with global warming potential (GWP-AR5). Of these emissions, approximately 26% are attributed to agricultural activities (see Fig. 1). Of the total of 565 million tons of CO^2e generated by this sector, about 30% are due to soil management. Therefore, we conducted an environmental convergence analysis in a highly relevant context for the formulation of CO^2 emissions mitigation policies.

Fig. 1 Distribution of CO^2e emissions by sector in Brazil, 2019



Source: Prepared by the authors, with data from the SEEG.

To investigate the convergence process in direct CO^2 emissions from agriculture (managed soils) in Brazilian states, we used a log t-test and the Phillips and Sul (2007) clustering algorithm. [3] Next, we estimated the factors determining the formation of convergence clubs in carbon emissions from agriculture through a Probit model. Employing this approach, we found evidence for the existence of two convergence clubs in CO^2 emissions from Brazilian agriculture associated with soil management. A convergence club is composed of 9 (33%) Brazilian states with high CO^2 emissions, and the other is formed of 18 (67%) states with low emissions. Land use, labor, capital, bovine density, agricultural production, industrial production, rural credit, and energy consumption are identified as drivers for the formation of these convergence clubs. Comparing the CO^2 emissions of these convergence clubs before and after the Kyoto Protocol came into effect, we discovered that environmental sustainability in the Brazilian agricultural sector has been largely neglected.

The results obtained in this study contribute to an evolving literature that examines the process of convergence in carbon emissions and its determinants in the agricultural sector in various ways (Akran and Ali (2021), Akram et al. (2020), Wu et al. (2019), Morales-Lage et al. (2019), and Oliveira and Bourscheidt (2017)). Firstly, we examined the CO^2 emissions from managed soils in Brazil, also referred to as direct emissions from the agricultural sector, for the first time. These

[2] Information obtained from IBGE (September 24, 2023).

[3] The main advantage of this approach is that it captures the heterogeneity of economies without imposing specific assumptions of stochastic stationarity on the trend (Apergis and Payne, 2017).

emissions result from the intensive use of limestone and urea (fertilizers), which are widely utilized inputs in national agriculture to control soil acidity and increase land productivity for cultivation (Zilli et al., 2020; Melo Benites et al., 2023). Second, most studies conducted on carbon emissions in agriculture focus on the national level, masking subnational differences or suffering from data imprecision in carbon emissions since countries adopt different methods to calculate their pollution levels. By concentrating our analysis on the convergence process of agricultural emissions at the state level within a single country, we minimize the potential bias associated with data heterogeneity across countries (Ivanovski and Churchill, 2020). Third, in studying this form of pollution, we employ a temporal horizon that enables us to capture changes in Brazilian agricultural production and the dynamics of its carbon emissions (1975-2019). This sets us apart from other studies conducted for Brazil, which rely on carbon emissions data only from the 1990s onwards (see, for example, Amorim et al. (2023) and Amarante et al. (2022)). Finally, we add new evidence on the factors influencing the accumulation of CO^2 emissions in agriculture, specifically for managed soils.

The remainder of the study is organized as follows. The next section provides a theoretical review of economic and environmental convergence and convergence clubs. Then, in Section 3, we discuss the details of the empirical data and the methodology of Phillips and Sul (2007). Section 4 presents the results. Finally, Section 5 presents the conclusions and policy recommendations for Brazil.

2. THEORETICAL REVIEW

2.1 Economic convergence and convergence clubs

Economic convergence has played a key role in economic growth theory since the seminal study by Baumol (1986). This seminal study hypothesized that poorer economies are able to catch up with more advanced economies in terms of per capita income over time. Based on Solow's (1956; 1957) growth model, Barro and Sala-i-Martin (1992) and Mankiw et al. (1992) provide concrete evidence of this phenomenon. These early studies showed that when preferences and technologies are similar across countries, differences in per capita income between lagging and advanced economies tend to gradually decrease, leading to convergence to a common steady state (Sofi and Durai, 2016; Borsi and Metiu, 2015). In other terms, they confirm the prediction of the Solow model, which, based on the assumption of diminishing returns of the capital stock to output, anticipates convergence of incomes across economies in the long run.

Durlauf and Johnson (1995) and Hansen (2000) showed that, instead of a single global equilibrium, convergence could occur within different economic groups, each with distinct balanced growth regimes. This implies that multiple locally stable equilibria can emerge as a result of a dynamic system, which tends to lead to different growth patterns (Ergodan and Okumus, 2021). These distinct growth patterns are referred to as “convergence clubs”, a term coined based on the contributions of Quah (1996). Following this discussion, Galor (1996) emphasizes that the analysis of economic convergence has been centered on three hypotheses:

a) *Unconditional convergence:* Over time, all economies reach the same per capita income level, regardless of their starting conditions.

b) *Conditional convergence:* Economies with similar structural factors like investment rates, technology, human capital, population growth, and policies will converge in the long term, irrespective of their initial conditions.

c) *Convergence clubs:* Economies with both similar structural characteristics and identical initial conditions will form clubs and converge to the same per capita income level in the long run.

2.2 Environmental convergence

This paper is based on this theoretical framework, as well as on the early studies of economic convergence that were guided by the Solow model. We follow a perspective that fits into the concept of environmental convergence clubs. This approach is supported by the contribution of Brock and Taylor (2010), who introduced essential considerations about pollutant emission flows, notably carbon emissions, within the framework of the Solow growth model. This theoretical model, known as the “Green Solow”, lays the necessary groundwork for conducting empirical studies on the process

of convergence or divergence of economies with respect to carbon emissions. In the case of this study, we focus on carbon emissions (CO^2) from agricultural production.

Environmental convergence corresponds to a phenomenon in which environmental disparities (carbon emissions) between different economies tend to decrease as these economies develop economically and adopt more sustainable policies and practices (Lawson et al., 2020; Bulte et al., 2007). This concept of environmental convergence is based on two fundamental economic premises. First, it is linked to the convergence assumptions outlined by Galor (1996). Second, it is grounded in the theory of the Environmental Kuznets Curve (EKC), originally proposed by Grossman and Krueger (1995). According to the EKC hypothesis, environmental pollution tends to increase in parallel with economic growth in the early stages of development but tends to decrease as income reaches higher levels from a long-term perspective of economic development.

The Green Solow model developed by Brock and Taylor (2010) offers a coherent explanation that links economic and environmental convergence. [4] Specifically, this model shows that the validity of the EKC is an intrinsic outcome of the convergence process toward a sustainable growth pattern. To achieve this, the model assumes that environmental pollution is an inherent byproduct of consumption in capitalist society. In this context, technological changes in the productive sector become inevitable to promote the expansion of wealth. Consequently, technological progress to reduce environmental degradation must outpace the pace of average production growth. In practice, this reduction in pollution becomes tangible through initiatives that lead to increasing returns to scale. These gains are generally achieved through investments in clean and efficient technologies that promote the rational use of factors of production (Pettersson et al., 2014).

Brock and Taylor (2010) argue that exogenous technological transformations play a central role in determining the long-term growth of economies. This premise supports the idea that carbon emissions tend to decrease as income rises to higher levels. This leads to a conditional convergence of carbon emissions toward the steady state. In the short term, however, each economy converges on its own growth path, both in terms of income and carbon emissions. From this perspective, it is possible to observe a scenario in which economies with modest growth rates face an increase in carbon emissions, while those with more pronounced growth rates may experience a decrease in pollution. In this regard, differences in income growth rates across economies prove to be an important factor. If these differences are significant, there is a possibility that carbon emissions will diverge across economies. Conversely, if these differences are reduced, space opens up for convergence among economies in terms of carbon emissions (Pettersson et al., 2014).

This theoretical review provides the economic foundation for analyzing carbon emissions (CO^2) resulting from the growth of production and income in the agricultural sector of Brazil. The only explicit difference is that we are considering only income derived from agricultural activity, that is, the idea of economic growth in agriculture. Furthermore, the concepts of environmental convergence (i.e., the convergence of carbon emissions) and environmental convergence clubs (i.e., carbon emissions clubs) are analogous to the concepts of economic convergence and convergence clubs presented in section 2.1.

3. METHODOLOGY

3.1 Data

This study uses a balanced panel data set from all 27 federal units of Brazil – 26 states and the Federal District – and covers the period from 1975 to 2019.[5] CO^2 emissions from the agricultural sector are from the *Sistema de Estimativas de Emissão de Gases de Efeito Estufa* (SEEG – Brazil).[6]

[4] The derivation of the Green Solow model can be found in Brock and Taylor (2010).

[5] The Federal Units (FU) of Brazil are: Acre (AC), Alagoas (AL), Amapá (AP), Amazonas (AM), Bahia (BA), Ceará (CE), Distrito Federal (DF), Espírito Santo (ES), Goiás (GO), Maranhão (MA), Mato Grosso (MT), Mato Grosso do Sul (MS), Minas Gerais (MG), Pará (PA), Paraíba (PB), Paraná (PR), Pernambuco (PE), Piauí (PI), Rio de Janeiro (RJ), Rio Grande do Norte (RN), Rio Grande do Sul (RS), Rondônia (RO), Roraima (RR), Santa Catarina (SC), São Paulo (SP), Sergipe (SE), and Tocantins (TO).

[6] The methodology for estimating greenhouse gasses (GHGs), including CO^2 emissions from managed soil, can be found in the SEEG at the following address: www.seeg.eco.br. The State of Tocantins was established in 1988. Considering this, we applied a retrospective estimation method (retropolation method) of CO^2 emissions from agriculture for the emissions of this state from the year of its creation to 1975

CO^2 emissions from agricultural activity result from managed soils.[7] These CO^2 emissions are estimated based on the use of limestone and the application of urea, both of which are widely used in soil liming and agricultural fertilization. This form of pollution is called direct CO^2 emissions from agriculture (Kalkhoran et al., 2019).

To identify the factors that influence the formation of convergence clubs in CO^2 emissions from agriculture, we used information from different sources, such as the *Instituto de Pesquisa Econômica Aplicada* (IPEA), the *Instituto Brasileiro de Geografia e Estatística* (IBGE), and the *Banco Central do Brasil* (BACEN). We selected a set of variables associated with both the economic structure of Brazilian states, such as energy consumption and industrial production, and the production and inputs of the agricultural sector, including capital, labor, land use, and access to rural credit. In addition, we included bovine density as a measure of livestock activity. These variables were selected based on previous research showing their importance as drivers of CO^2 emissions in the agricultural sector (Liu et al., 2021; Xu and Lin, 2017). Therefore, they are also expected to influence the formation of convergence clubs in this study. A detailed description of the variables used can be found in Table A1 of the Appendix.

3.2. The log t-test and the convergence clubs

The log t-test developed by Phillips and Sul (2007; 2009) allows the analysis of the transitional behavior of carbon emissions from agriculture in Brazilian states during the period from 1975 to 2019.[8] The CO^2 emissions from agriculture in the Brazilian states are denoted by X_{it} , which can be decomposed into systematic h_{it} and transient g_{it} elements based on the time-varying nonlinear factor model, as shown in Eq. (1) (Zhu and Lin, 2020).

$$X_{it} = h_{it} + g_{it} \quad (1)$$

Eq. (1) is then transformed into Eq. (2) to separate these components and capture the stochastic trend:

$$X_{it} = \left(\frac{h_{it}+g_{it}}{u_t}\right) u_t = \vartheta_{it} u_t, \quad \text{for all } i \text{ and } t. \qquad (2)$$

where $u_t$represents the single shared component that captures the behavior of the deterministic or stochastic trend, while ϑ_{it} is a time-varying idiosyncratic element that captures the distance between X_{it} and u_t.

The convergence of carbon emissions (X_{it}) requires that the limit as t approaches infinity of $\lim_{t\to\infty} \frac{X_{it}}{X_{jt}} = 1$ is 1 for any i and j, which represents the convergence of the idiosyncratic element over time, where $\lim_{t\to\infty} \vartheta_{it} = \vartheta$ for any i. Now we assume an idiosyncratic element ϑ_{it} with the following equation:

$$\vartheta_{it} = \vartheta_i + \gamma_{it}\xi_{it}, \ with \quad \gamma_{it} = \frac{\gamma_i}{L(t)t^{\alpha}}, \ t \geq 1, \ \gamma_i > 0 \text{ for all } i. \quad (3)$$

where $L(t)$ is a slowly varying function, which can also be defined as $\log(t)$ or as a $\log[\log(t)]$. Monte Carlo simulations presented by Phillips and Sul (2007) suggest that $L(t) = \log(t)$ exhibits less size distortion and better statistical test power. The $\log(t)$ regression test by Phillips and Sul (2007) has the null hypothesis ($h_0: \vartheta_i = \vartheta$ when $\alpha \geq 0$), indicating the convergence of carbon emissions in the agricultural sector to the Brazilian states. Against the alternative hypothesis ($h_1: \vartheta_i \neq \vartheta$ when $\alpha < 0$), indicating the absence of convergence.

As u_t is a common factor in Eq. (2), it may be removed by scaling to give the relative load or transition coefficient (f_{it}). This relative transition parameter (f_{it}) is used to remove the common factor and isolate the trend factor, which depicts a temporal transition path of state economies (i), but now with respect to the panel average over time (t), as shown in Eq. (4). The Eq. (4) also indicates that the cross-sectional average is one unit, while its cross-sectional adjustment variance must

[7] Fig. C1 in the Appendix presents the evolution of CO^2 emissions from Brazilian agriculture. CO^2 emissions from this economic activity have been growing at an average rate of 6.2% per year in Brazil

[8] Prior to applying this methodological process, the longitudinal carbon emission data were filtered to eliminate the cyclic component using the Hodrick-Prescott (HP) smoothing filter. This filtering process allows us to capture the temporal trend of carbon emissions and then apply the Phillips and Sul (2007;2009) approach.

satisfy the conditions outlined in Eq. (5), that is, meet the convergence condition as time approaches infinity ($t \to \infty$) (Phillips and Sul, 2007).

$$f_{it} = \frac{X_{it}}{\frac{1}{N}\sum_{i=1}^{N} X_{it}} = \frac{\vartheta_{it}}{\frac{1}{N}\sum_{i=1}^{N} \vartheta_{it}} \qquad (4)$$

$$F_{it} = \frac{1}{N}\sum_{i=1}^{N}(f_{it} - 1)^2 \to 0 \text{ if } \lim_{t\to\infty} \vartheta_{it} = \vartheta, \text{ for all } i. \qquad (5)$$

The $\log(t)$ regression model proposed by Phillips and Sul (2007) is used to implement the hypothesis tests presented earlier:

$$\log\left(\frac{F_1}{F_t}\right) - 2\log\{\log(t)\} = a + b.\log(t) + \varepsilon_t, \text{ for } t = [rT], [rT]+1, \cdots, T \text{ with } r > 0. \quad (6)$$

where $r \in (0,1)$ represents the initial proportion of the discarded sample. Phillips and Sul (2007) initially suggest using an $r \in \{0.2, 0.3\}$.

For $b = 2\alpha$, a robust one-sided t-test for heteroscedasticity and autocorrelation (HAC) can be used to test the inequality of the null hypothesis: $\alpha \geq 0$. Under certain technical assumptions, the asymptotic distribution of the log (t) regression statistic is $t_b = \frac{\hat{b}-b}{s_b} \Rightarrow N(0,1)$. In this context, the null hypothesis of convergence should be rejected at the 5% significance level if $t_b < -1{,}65$.

Although it is possible to reject the null hypothesis that would suggest a lack of convergence in CO^2 emissions from agriculture across the entire sample of states, it is important to consider the possibility of convergence within subgroups (clubs). Phillips and Sul (2007; 2009) provide a clustering algorithm, adjusted by Schnurbus et al. (2017), to identify clubs of convergence. We use this algorithm to identify convergence clubs in CO^2 emissions as well as the possibility of mergers between clubs. The result of this process is called final clubs. A detailed description of the process can be found in Du (2017).

3.3 The Ordered Probit model

In the second stage of the analysis, we are interested in identifying the factors that influence the formation of convergence clubs in CO^2 emissions in the agricultural sector. Specifically, we assume that the 27 Brazilian states can form J final convergence clubs, where we assign $Y_i \in \{1, 2, \ldots, J\}$ to to these clubs ordered by the average level of CO^2 emissions of each club, i.e., from the club with the lowest emissions to the highest, as in Eq. (7) (Zhu and Lin, 2020).

$$Y_i^* = X_i'\beta + \varepsilon_i\,, \quad i = 1, 2, \ldots, N \quad \text{and} \quad Y_i = \begin{cases} 1, & \text{if} \quad Y_i^* \leq k_1 \\ 2, & \text{if} \quad k_1 < Y_i^* \\ \vdots & \vdots \\ J, & \text{if} \quad k_{J-1} < Y_i^* \leq k_j \end{cases} \qquad (7)$$

Where X_i is a set of potential determinants for the formation of convergence clubs; β corresponds to the coefficient to be estimated; Y_i^* is the latent variable, representing convergence clubs for different cutoff points (k), while ε_i is a random error term, assumed to follow a normal distribution.

This empirical equation is estimated using the ordered Probit model, which involves estimating a conditional probability function with the categorical and ordered dependent variable. The coefficients to be estimated maximize the likelihood function of the model. However, when there are only two convergence clubs, a conventional Probit model is estimated, which has a similar econometric structure (Cameron and Trivedi, 2005).

4. RESULTS

4.1 Result of the log t-test and convergence clubs

This section presents the results obtained by the convergence modeling of Phillips and Sul (2007;2009) for CO^2 emissions in the agricultural sector of Brazilian states. Table 1 presents the

results of the log t-test for CO² emissions in agriculture in all states for the period from 1975 to 2019. The test performed rejects the null hypothesis of convergence of emissions in all states at a 5% significance level with the estimate ($\hat{b} = -0.320$) and the statistic ($t_{\hat{b}} = -4.700$). This result indicates that the time series of CO² emissions in agriculture do not converge to a common steady state.

Table 1. Convergence clubs: CO² emissions from the agricultural

		N	$\hat{b}$ coeff.	Std.err	$t_{\hat{b}}$	$\hat{\alpha}$
Panel A. Club convergence tests						
All states		27	-0.320	0.068	-4.700*	
Club 1	MT, MG, SP, PR, RS, GO, MS, TO, PA.	9	0.174	0.066	2.658	0.087
Club 2	BA, SC, PI, MA, CE, ES, RO, SE, AL, PB, PE, RN, DF, AM, RJ, AC, RR, AP.	18	0.141	0.109	1.287	0.071
Panel B. Merging analysis						
No clubs can be merged.						
Panel C. Final club convergence						
Club 1	MT, MG, SP, PR, RS, GO, MS, TO, PA.					
Club 2	BA, SC, PI, MA, CE, ES, RO, SE, AL, PB, PE, RN, DF, AM, RJ, AC, RR, AP.					

Source: Prepared by the authors.

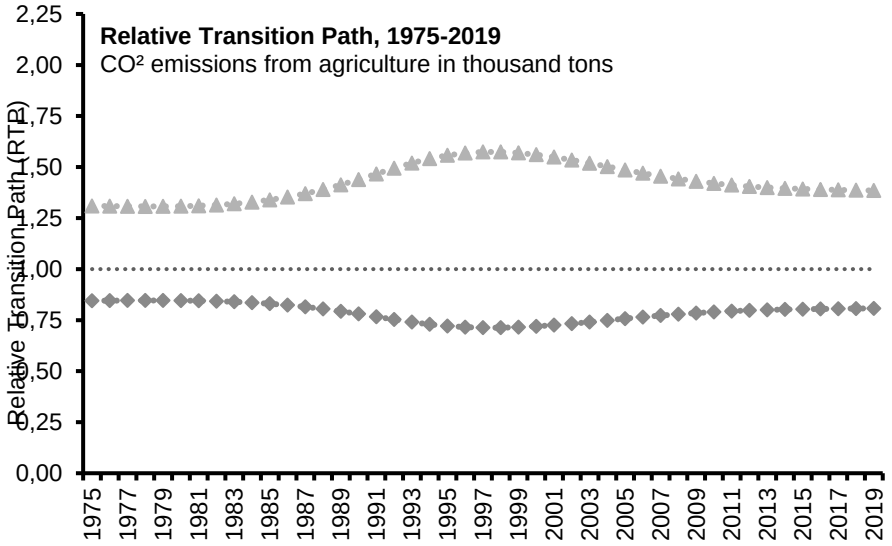
Notes: Table reports the log(t) regression test. $\hat{\alpha}$ is the speed of adjustment parameter calculated as $\hat{b}\backslash 2$. (*) Indicates rejection of the null hypothesis of convergence at the 5% level.

The absence of absolute convergence for all Brazilian states leads to the regression of log (t) for a second level of analysis, where the null hypothesis of the existence of convergence clubs is tested. Following the approach of Phillips and Sul (2007; 2009), we identify two convergence clubs in CO² emissions in the agricultural sector, since we cannot reject the null hypothesis at the 95% confidence level. Using this procedure, we identify a club with high CO² emissions in agriculture, composed of 9 (33%) Brazilian states, and another club with low emissions, formed of another 18 (67%) states. Since $b = 2\alpha$, the rate of convergence of the clubs can be calculated as $\alpha = b/2$, with $0 \leq \alpha < 1$. Thus, the convergence clubs of high and low CO² emissions in agriculture conditionally converge (convergence of growth rates) at a rate of 0.087 and 0.071, respectively. Although the value of $\hat{\alpha}$ for CO² emissions suggests a relatively low rate of adjustment, the convergence of growth rates is still achieved for the identified clubs. We examine this form of convergence in more detail in Section 4.3, where we use a model that controls for unobservable and time-invariant factors affecting CO² emissions in Brazilian agriculture.

The spatial distribution of Brazilian states in clubs of high and low CO² emissions in agriculture, as well as the average CO² emissions in thousand tons from 1975 to 2019, are presented in Figs. B1 and B2 in the Appendix. The states that make up the high CO² emissions in agriculture club are located in the Central-West, South-East, and South Brazil regions, where competitive agriculture is developed with intensive use of technology and modern inputs for soil management and achieving economies of scale in food production. On the other hand, the states that make up the club of low CO² emissions are located in the North and Northeast of the country, where agricultural activity is still developing traditionally, i.e., with low technological intensity and severe limitation of economic resources (Pereira et al., 2012).

The relative transition paths (RTPs) for the two convergence clubs, corresponding to the steady-state trajectory of the clubs approximated by the mean of the filtered CO² emission series, are presented in Fig. 2. As can be seen, Club 1 (high emission) remains above the stability line, while Club 2 (low emission) remains below it. The trajectory indicates that agricultural production in the Brazilian states still faces significant challenges in reducing carbon emissions and improving environmental sustainability in the clubs. This requires urgent changes in the production system, especially in the context of global warming and the paradigm shift that is taking place in the agricultural sector (Amorim et al., 2023; Martinelli et al., 2016).

Fig. 2 Average transition paths per club – CO² emissions from agriculture



Source: Prepared by the authors.

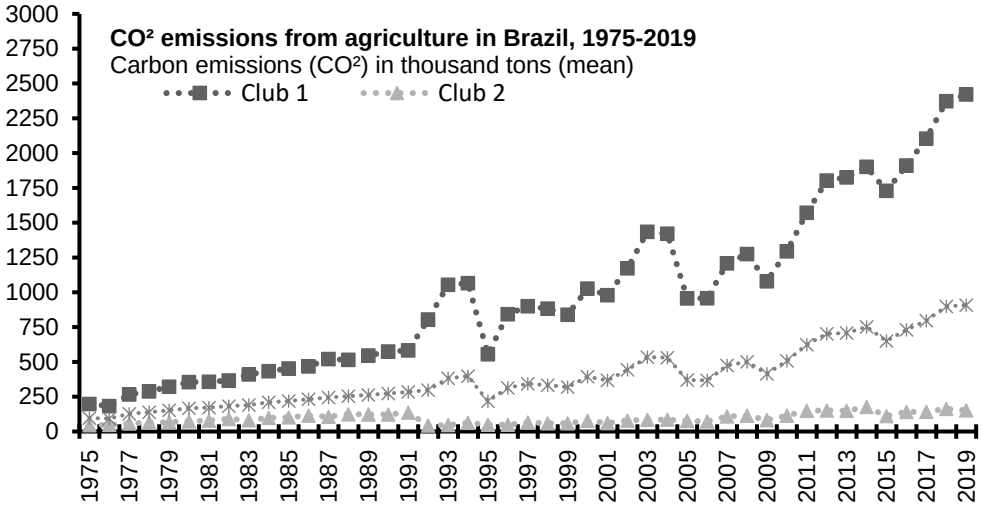
4.2 CO² emissions in agriculture by convergence clubs

Fig. 3 presents the average trend of CO² emissions from the agricultural sector, covering both the two identified convergence clubs and all Brazilian states, during the period from 1975 to 2019. As can be seen, there is a notable trend of average growth in CO² emissions from agriculture in Club 1. In this scenario, we note a substantial increase, from 197 thousand tons in 1975 to a significant 2,421 thousand tons in 2019, which represents an increase of more than 12 times compared to the initial average value. On the other hand, Club 2 also shows an average increase in CO² emissions from agriculture, from 45.9 thousand tons in 1975 to 152.4 thousand tons in 2019, which is equivalent to an increase of more than three times compared to the initial average value. Furthermore, the trajectory of Club 2 is more stable and controlled over time than that of Club 1.

The results indicate that CO² emissions from the agricultural sector are, to some extent, controlled in most Brazilian states. This is particularly noteworthy due to the scope of Club 2, which includes about 70% of the states in the national territory. However, on the other hand, some states that belong to Club 1 have concentrated a significant share of CO² emissions, making it crucial to implement specific policies to combat pollution resulting from inadequate soil management practices. These policies may include stricter environmental regulations, soil management programs, incentives and subsidies to expand conservation agricultural areas, and promotion of access to rural credit at lower interest rates for producers who commit to adopting more efficient and low-carbon agricultural technologies (Anghinoni et al., 2021). Such actions aim not only to reduce CO² emissions but also to promote more efficient management of natural resources, contributing to the sustainable development of food production in Brazilian territory.

To provide a more comprehensive overview of CO² emissions from Brazilian agriculture, we provide descriptive statistics for the convergence clubs and for all states in the sample in Table 2. Based on these statistics, we find that for the period from 1975 to 2019, the average CO² emissions of the sector for Club 1 are 982.7 thousand tons, with an average annual growth rate of 23%. For Club 2, the average CO² emissions reached about 94.85 thousand tons, with an average annual growth rate of 24.1%. Considering all states, the average CO² emissions in agriculture were 390.8 thousand tons, accompanied by an average annual growth rate of 23.75%. This trend of pollution in the agricultural sector is of great concern, as the Brazilian economy urgently needs to control its CO² emissions in order to achieve the greenhouse gas reduction targets established under the Paris Agreement (Lima et al., 2020).

Fig. 3 Average trend of CO² emissions from agriculture by club



Source: Prepared by the authors.

Table 2. Descriptive statistics and average growth rate

Clubs	Average growth (%)	Descriptive statistics				
		Mean	Std. dev.	Median	Min.	Max.
Club 1	23.05	982.69	898.43	780.06	3.49	5,349.68
Club 2	24.11	94.84	127.65	42.07	0.09	661.72
All states	23.76	390.79	674.38	91.87	0.09	5,349.68

Source: Prepared by the authors, with data from the SEEG.
Notes: CO² emissions from agriculture in thousand tons.

Next, we analyzed CO² emissions from agriculture for both the convergence clubs and the entire sample, comparing the periods before (1975-2004) and after (2005-2019) the implementation of the Kyoto Protocol (Table 3). [9] It is important to note that among developing countries, Brazil has voluntarily committed to reducing its GHG emissions as part of its efforts to mitigate ongoing climate change (Oliveira et al., 2019).

Table 3. CO² emissions from the agricultural before and after the Kyoto Protocol

Clubs	Before Kyoto		After Kyoto		Change	
	Mean	Std. dev.	Mean	Std. dev.	Difference	Growth (%)
Club 1	660.49	618.44	1,627.10	1,018.94	966.62	146.35
Club 2	78.71	104.17	127.10	160.30	48.39	61.48
All states	272.64	457.94	627.10	928.82	354.47	130.01

Source: Prepared by the authors, with data from the SEEG.
Notes: CO² emissions from agriculture in thousand tons.

Before the entry into force of the Kyoto Protocol, the CO² emissions from the agricultural sector for Clubs 1 and 2 were, on average, 660 thousand tons and 79 thousand tons, respectively. After the implementation of the Kyoto Protocol, the CO² emissions for Clubs 1 and 2 increased, on average, to 1,627 and 127 thousand tons, respectively. This represented an increase of 996 thousand tons and 48 thousand tons in the CO² emissions from agriculture for Clubs 1 and 2, which corresponds to a growth of 146.5% and 61.5%, respectively. Within the scope of all Brazilian states, there was a significant average increase of 354 thousand tons in the CO² emissions from agriculture before and after this international agreement, indicating a growth of 130%.

The remarkable increase of CO² emissions in agriculture underlines that the environmental sustainability of this economic activity has been largely neglected in Brazil in recent decades. The increase in pollution in the agricultural sector can also be attributed to the impressive growth that the country has registered since 2003. This period was characterized by a boom in agricultural commodity prices, triggered by the increase in global demand for food. To meet this growing demand, Brazilian producers have intensified their agricultural practices to increase crop productivity. One

[9] During the period of the Kyoto Protocol, Brazil voluntarily committed to reduce its emissions by 36.1% to 38.9% from 1990 levels. Currently, this protocol has been replaced by the Paris Agreement, as many developed countries have not ratified it as of 2005, such as the United States (Oliveira et al., 2019).

of the strategies implemented was a significant increase in the use of limestone and fertilizers to improve soil quality. This practice helped to optimize growing conditions for crops, resulting in higher yields. However, this intensification of agriculture also had a significant impact on the environment. The increasing use of limestone and fertilizers led to an increase in CO^2 emissions, moving the country away from its GHG reduction targets (Pereira et al., 2012).

Table 4 presents a comparison of CO^2 emissions from agriculture before and after the implementation of the Kyoto Protocol for the different Brazilian states. The table is organized to show the average difference in CO^2 emissions from agriculture in a thousand tons before and after the adoption of the Kyoto Protocol, ordered in descending order by the degree of emission of the Brazilian states. Analyzing the change in the average level of CO^2 emissions from agriculture before and after this international agreement, we note that only the states of Pernambuco (-56 thousand tons), Sergipe (-24.35 thousand tons), and Paraíba (-1.65 thousand tons), all belonging to Club 2, show a reduction in their emissions. On the other hand, the states of Mato Grosso (+ 2,249.68 thousand tons), Minas Gerais (+ 1,502.08 thousand tons), and São Paulo (+ 1,143.86 thousand tons), which belong to Club 1, show the greatest increase in carbon emissions from agriculture. In general, the results show that CO^2 emissions increase faster in Brazilian states where agriculture has an intensive use of technology, capital, and fertilizers.

Table 4. CO^2 emissions from the agricultural before and after the Kyoto Protocol

Clubs	State	Before Kyoto		After Kyoto		Before and After Kyoto	
		Mean	Std. dev.	Mean	Std. dev.	Difference	Growth (%)
2	PE	112.15	58.08	56.19	30.36	-55.96	-49.89
2	AL	73.79	26.40	49.44	27.69	-24.35	-33.00
2	PB	71.76	54.46	70.11	26.51	-1.65	-2.30
2	RJ	22.28	14.80	26.59	11.22	4.31	19.33
2	AP	0.52	0.33	5.32	3.01	4.80	915.80
2	RN	46.53	33.93	51.67	18.78	5.14	11.05
2	RR	1.87	1.33	10.70	4.43	8.83	473.26
2	AC	5.23	4.43	19.19	11.37	13.97	267.12
2	DF	15.98	62.21	29.97	13.62	13.99	87.51
2	AM	7.39	4.80	24.90	12.84	17.51	236.83
2	MA	165.56	57.65	183.26	158.27	17.70	10.69
2	SE	18.44	13.00	64.39	26.87	45.95	249.13
2	RO	24.27	22.55	101.96	47.38	77.69	320.07
2	ES	79.09	38.17	159.10	58.33	80.01	101.16
2	SC	322.49	118.36	449.51	94.32	127.02	39.39
2	CE	114.83	86.13	242.65	113.54	127.82	111.31
1	PA	40.93	29.06	211.33	88.96	170.40	416.31
2	PI	68.08	60.73	246.80	124.98	178.72	262.50
2	BA	266.54	108.50	496.08	169.70	229.55	86.12
1	TO	76.95	79.36	553.72	375.75	476.77	619.55
1	RS	1,037.15	321.91	1,568.47	546.33	531.31	51.23
1	PR	1,065.92	474.02	1,848.12	453.07	782.19	73.38
1	GO	631.24	448.60	1,544.50	486.33	913.25	144.67
1	MS	323.87	229.28	1,253.88	503.90	930.01	287.15
1	SP	1,240.23	690.35	2,384.10	380.49	1,143.86	92.23
1	MG	812.56	447.74	2,314.63	540.37	1,502.08	184.86
1	MT	715.51	849.90	2,965.18	1,312.96	2,249.68	314.42

Source: Prepared by the authors, with data from the SEEG.
Notes: CO^2 emissions from agriculture in thousand tons.

Our previous results show that strategies to control CO^2 emissions in the Brazilian agricultural sector are necessary, but should not be applied uniformly and deliberately. We identified two convergence clubs with different levels of carbon emissions. Therefore, government planners, policymakers, and entrepreneurs in the agricultural sector need to consider these differences in order to adopt more effective approaches to reduce CO^2 emissions. In addition, they must consider the aspects of carbon emissions in the states that are part of each convergence club. These aspects include geographic, economic, environmental, and institutional factors (Lamb et al., 2021). In Section 4.4, we provide guidance on the productive and economic characteristics of the states that are part of the convergence clubs. This will help inform the design of more assertive policies to reduce carbon emissions in the Brazilian agricultural sector.

4.3 Results of β-convergence test

The grouping algorithm reveals the presence of convergence clubs with regard to CO^2 emissions in the Brazilian agricultural sector. Now, we seek to analyze more specifically the β-convergence of clubs in CO^2 emissions, which includes the calculation of the convergence speed and half-life. When we refer to β-convergence in CO^2 emissions in agriculture, we are considering a theoretical framework similar to that of the income. In this framework, the richer states in agricultural production that started with higher levels of emissions have a relatively higher rate of reduction in terms of pollution over time compared to the poorer states in terms of agricultural production that started with lower levels of emissions (Pettersson et al., 2014).

To test this hypothesis, we used a model that consists of a regression with a fixed effect estimator, where the growth rate of CO^2 emissions in agriculture is regressed on its initial level. Therefore, we conducted the β-convergence test on CO^2emissions in agriculture for the two identified clubs. If the estimated coefficient for this regression is negative and statistically significant, we can conclude that the β-convergence phenomenon exists (Runar et al., 2017; Zhu and Lin, 2020).

The results of these estimates are presented in Table 5. As expected, the estimated coefficients for the initial value of CO^2 emissions in agriculture are negative and statistically significant at the 1% level for each of the convergence clubs. This strongly suggests the existence of β-convergence in clubs, that is, that CO^2 emissions in agriculture are converging to their own stationary state in each club.

Table 5. β-convergence test for final clubs

	Club 1	**Club 2**
Coefficient	-0.300	-0.243
	[0.073]***	[0.040]***
Speed of convergence (%)	0.70	0.50
Half-Life (years)	104	128
State-fixed effects	Yes	Yes
Year-fixed effects	Yes	Yes
Adjusted-R2	0.342	0.501
Number of states	9	18

Source: Prepared by the authors.
Notes: Robust standard error in brackets. *p<0.1, **p<0.05, ***p<0.01.

The convergence speed refers to the rate at which states with lower levels of agricultural CO^2 emissions are approaching states with higher emission levels. In relation to the half-life, this is interpreted as half the time it takes for states to reach half the distance to their steady state in terms of CO^2 emissions (Pettersson et al., 2014). For Clubs 1 and 2, the estimated absolute convergence speed is 0.7% and 0.5% per year, indicating that the time required to halve the difference in agricultural CO^2 emissions between states with lower emissions and those with higher emissions is, on average, 104 and 128 years, respectively.

In general, the results point to a slow process of convergence in CO^2 emissions from the Brazilian agricultural sector. This requires immediate action if the country wants to meet its short- and medium-term GHG mitigation targets. The slowness in the convergence process can be due to several factors, such as resistance to change by agricultural producers, lack of investment in clean technologies, and reliance on limestone and urea (fertilizer) to increase agricultural productivity. In this context, long-term policies are needed to promote sustainable agricultural practices. Cooperation between states by club can facilitate the adoption of policies and best agricultural practices, and consequently accelerate the process of convergence of CO^2 emissions in agriculture (Amorim et al., 2023).

4.4 Drivers that affect the formation of convergence clubs

The last part of the empirical analysis of this study aims to deepen the understanding of the factors that influence the formation of convergence clubs in carbon emissions of the Brazilian agricultural sector. To achieve this objective, we use a conventional Probit model to identify the elements that influence the formation of the previously identified convergence clubs. The factors considered in the analysis of club formation are based on the studies of Liu et al. (2021) and Xu and Lin (2017) for Chinese agriculture. Thus, we focus specifically on examining the role that agricultural production factors and the production structure of Brazilian states play in the formation of convergence clubs.

The results of the Probit model are presented in Table 6. It is important to note that all coefficients are statistically significant at the 1% level. When examining the coefficients, we notice that several factors influence the formation of convergence clubs in emissions from the agricultural sector over time. Among these factors, land use, rural labor, cattle density, and industrial production stand out, all of which are associated with a lower probability of a state belonging to Club 1 (high carbon emissions). On the other hand, factors such as capital, agricultural production, rural credit, and energy consumption decrease the probability of a state belonging to Club 2 (low carbon emissions). In other words, these latter factors increase the probability of a state belonging to Club 1, which represents states converging towards high carbon emissions in the agricultural sector. In general terms, land use, labor, capital, cattle density, agricultural production, industrial production, rural credit, and energy consumption are identified as drivers for the formation of these convergence clubs.

Table 6. Regression results of the Probit model

Variables	Coefficient
Rural land use	-0.075
	[0.006]***
Rural capital	1.128
	[0.252]***
Rural labor	-1.675
	[0.157]***
Bovine density	-1.382
	[0.173]***
Agricultural output	0.772
	[0.156]***
Industrial output	-0.995
	[0.148]***
Rural credit	1.187
	[0.152]***
Energy consumption	0.570
	[0.140]***
Number of states	27
Observations	1,215
Pseudo R^2	0.705
Log pseudolikelihood	-228.19
Wald chi2	572.40***

Source: Prepared by the authors.
Notes: Robust standard error in brackets. Statistical significance: *p<0.1, **p<0.05, ***p<0.01.

This finding for Club 1 is consistent with the average concentration of CO^2 emissions from agriculture in states in the Midwest, Southeast, and South of Brazil (see Appendix Fig. B2). In these regions, the economic structure of the states is more advanced, and agricultural production is characterized by the use of modern inputs (capital and fertilizers) and agricultural technologies. On the other hand, the states that form Club 2 are mostly located in the North and Northeast regions of Brazil, where livestock farming plays an important role, and agriculture is characterized by its extensive nature and labor intensity in the field. In general, we find that the results of the Probit model are consistent with the characteristics of the states that form the convergence clubs with low and high carbon emissions in Brazilian agriculture.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

In the last decades, Brazil has experienced rapid growth in agricultural production, accompanied by significant penetration of its commodities in the world market. The country is one of the largest food producers in the world. However, economic growth based on the production and export of agricultural commodities has been accompanied by serious environmental problems, such as the increase in carbon dioxide (CO^2) emissions from soil managed, especially due to the intensive use of limestone and urea (fertilizer) to increase crop productivity. As a result, this has increasingly contributed to the country moving away from its CO^2 mitigation goals.

Differently from other developing countries, Brazil has set ambitious targets to reduce carbon emissions, both under the Kyoto Protocol, which is no longer in force, and under the Paris Agreement. However, these ambitious goals have proven difficult to achieve, as the country's economic growth is linked to the exploitation of natural resources and food production systems that do not yet meet the environmental quality standards required to address global issues such as climate change. Consequently, understanding the dynamics of CO^2 emissions from agriculture in all Brazilian states is important for the formulation of policies that contribute to achieving short- and medium-term carbon emission reduction goals. Currently, CO^2 emissions from the managed soil in the agricultural (in tons) represent the fourth-largest source of emissions in Brazil.

Considering this context, the main objective of this article was to study the convergence patterns of direct carbon dioxide (CO^2) emissions from the agricultural sector (soil managed), focusing on the states of Brazil. For this purpose, we used the convergence clubs approach developed by Phillips and Sul (2007; 2009), covering the period from 1975 to 2019 and all 27 federal units of the country. Empirical results indicate that there are two convergence clubs for CO^2 emissions from agriculture. The high emissions club consists of nine states in the Central-West, South-East, and South Brazil regions, where agricultural development is characterized by modern and technology-intensive production systems, capital, and fertilizers. In contrast, the club of low-emission states, composed of 18 states, is mainly located in the North and Northeast, where agricultural production systems are still traditional. When we compare the level of CO^2 emissions from agriculture for these convergence clubs before and after the Kyoto Protocol came into force, we find that environmental sustainability in this sector was largely neglected during the period under study.

We also conducted an analysis to explore the potential drivers of the formation of these convergence clubs. We examined the role of agricultural production factors and economic structure in the formation of convergence clubs. The results of this analysis suggest that land use, rural labor, bovine density, and industrial production are all associated with an increased probability of states forming the low CO^2 emissions club. On the other hand, factors such as agricultural production, rural capital, rural credit, and energy consumption tend to increase the probability of states forming the high CO^2 emissions club. In general, these factors are key determinants of the formation of convergence clubs in CO^2 emissions from soil management in Brazil's agricultural sector.

Based on the results of our investigation, we recommend that the Brazilian government adopt regulatory policies for the states within the high and low CO^2 emission clubs in agriculture. The creation of a regulatory environment aligned with the productive and environmental characteristics of the states belonging to each identified convergence club aims to encourage the transition to more sustainable agricultural practices in Brazilian states, with the purpose of reducing CO^2 emissions related to soil management (use of limestone and fertilizers) and promoting ecosystem preservation. As a result, it is expected that pollution control in the agricultural sector will occur, and the CO^2 mitigation targets promised by Brazil to the international community will be achieved.

Finally, we present directions for future research. We believe it would be highly beneficial to investigate whether convergence can be achieved regarding other greenhouse gases in the context of Brazilian agriculture. We also recommend that subsequent studies focus on the analysis of the convergence of CO^2 emissions at the local level, with the aim of providing more detailed information that can enrich the development of carbon emissions control policies in agriculture.

REFERENCES

Adebayo, T. S., Awosusi, A. A., Odugbesan, J. A., Akinsola, G. D., Wong, W. K., & Rjoub, H. (2021). Sustainability of energy-induced growth nexus in Brazil: do carbon emissions and urbanization matter?. *Sustainability*, *13*(8), 4371.

Akram, V., & Ali, J. (2021). Global disparities of greenhouse gas emissions in agriculture sector: panel club convergence analysis. *Environmental Science and Pollution Research*, *28*(39), 55615-55622.

Akram, V., Sahoo, P. K., & Rath, B. N. (2020). A sector-level analysis of output club convergence in case of a global economy. *Journal of Economic Studies*, *47*(4), 747-767.

Amarante, J. C. A., Besarria, C. D. N., Souza, H. G. D., & dos Anjos Junior, O. R. (2021). The relationship between economic growth, renewable and nonrenewable energy use and CO 2 emissions: empirical evidences for Brazil. *Greenhouse Gases: Science and Technology*, *11*(3), 411-431.

Amorim, D. I. M., da Silva, M. J. N., Silva Tabosa, F. J., Nunes de Almeida, A., & de Carvalho Castelar, P. U. (2023). Greenhouse gas emissions from Brazilian agriculture and convergence clubs. *International Review of Applied Economics*, 1-21.

Anghinoni, G., Anghinoni, F. B. G., Tormena, C. A., Braccini, A. L., de Carvalho Mendes, I., Zancanaro, L., & Lal, R. (2021). Conservation agriculture strengthen sustainability of Brazilian grain production and food security. *Land use policy*, *108*, 105591.

Apergis, N., & Payne, J. E. (2017). Per capita carbon dioxide emissions across US states by sector and fossil fuel source: evidence from club convergence tests. *Energy Economics*, *63*, 365-372.

Appiah, K., Du, J., & Poku, J. (2018). Causal relationship between agricultural production and carbon dioxide emissions in selected emerging economies. *Environmental Science and Pollution Research*, *25*, 24764-24777.

Aye, G. C., & Edoja, P. E. (2017). Effect of economic growth on CO^2 emission in developing countries: Evidence from a dynamic panel threshold model. *Cogent Economics & Finance*, *5*(1), 1379239.

Balsalobre-Lorente, D., Driha, O. M., Bekun, F. V., & Osundina, O. A. (2019). Do agricultural activities induce carbon emissions? The BRICS experience. *Environmental Science and Pollution Research*, *26*, 25218-25234.

Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. Journal of Political Economy, 100(2), 223-251.

Baumol, W. J. (1986). Productivity growth, convergence, and welfare: what the long-run data show. American Economic Review, 1072-1085.

Borsi, M. T., & Metiu, N. (2015). The evolution of economic convergence in the European Union. *Empirical Economics*, *48*, 657-681.

Brock, W. A., & Taylor, M. S. (2010). The green Solow model. *Journal of Economic Growth*, *15*, 127-153.

Bulte, E., List, J. A., & Strazicich, M. C. (2007). Regulatory federalism and the distribution of air pollutant emissions. *Journal of Regional Science*, *47*(1), 155-178.

Burnett, J. W. (2016). Club convergence and clustering of US energy-related CO^2 emissions. *Resource and Energy Economics*, *46*, 62-84.

Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: methods and applications*. Cambridge university press.

Churchill, S. A., Inekwe, J., Smyth, R., & Zhang, X. (2019). R&D intensity and carbon emissions in the G7: 1870–2014. *Energy Economics*, *80*, 30-37.

Du, K. (2017). Econometric convergence test and club clustering using Stata. *The Stata Journal*, *17*(4), 882-900.

Durlauf, S. N., & Johnson, P. A. (1995). Multiple regimes and cross-country growth behaviour. *Journal of applied econometrics*, *10*(4), 365-384.

Erdogan, S., & Okumus, I. (2021). Stochastic and club convergence of ecological footprint: an empirical analysis for different income group of countries. *Ecological Indicators*, *121*, 107123.

Fernández, Y. F., López, M. F., & Blanco, B. O. (2018). Innovation for sustainability: the impact of R&D spending on CO^2 emissions. *Journal of cleaner production*, *172*, 3459-3467.

Galor, O. (1996). Convergence? Inferences from theoretical models. *The economic journal*, *106*(437), 1056-1069.

Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *The quarterly journal of economics*, *110*(2), 353-377.

Hansen, B. E. (2000). Sample splitting and threshold estimation. *Econometrica*, *68*(3), 575-603.

Ito, K. (2017). CO^2 emissions, renewable and non-renewable energy consumption, and economic growth: Evidence from panel data for developing countries. *International Economics*, *151*, 1-6.

Ivanovski, K., & Churchill, S. A. (2020). Convergence and determinants of greenhouse gas emissions in Australia: A regional analysis. *Energy Economics*, *92*, 104971.

Ivanovski, K., Churchill, S. A., & Smyth, R. (2018). A club convergence analysis of per capita energy consumption across Australian regions and sectors. *Energy Economics*, *76*, 519-531.

Kais, S., & Sami, H. (2016). An econometric study of the impact of economic growth and energy use on carbon emissions: panel data evidence from fifty-eight countries. *Renewable and Sustainable Energy Reviews*, *59*, 1101-1110.

Kalkhoran, S. S., Pannell, D. J., Thamo, T., White, B., & Polyakov, M. (2019). Soil acidity, lime application, nitrogen fertility, and greenhouse gas emissions: Optimizing their joint economic management. *Agricultural Systems*, *176*, 102684.

Khan, M. K., Khan, M. I., & Rehan, M. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial Innovation*, *6*, 1-13.

Khan, M. K., Teng, J. Z., & Khan, M. I. (2019). Effect of energy consumption and economic growth on carbon dioxide emissions in Pakistan with dynamic ARDL simulations approach. *Environmental Science and Pollution Research*, *26*, 23480-23490.

Khan, M., & Ozturk, I. (2021). Examining the direct and indirect effects of financial development on CO^2 emissions for 88 developing countries. *Journal of environmental management*, *293*, 112812.

Lamb, W. F., Wiedmann, T., Pongratz, J., Andrew, R., Crippa, M., Olivier, J. G., ... & Minx, J. (2021). A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018. *Environmental research letters*, *16*(7), 073005.

Lawson, L. A., Martino, R., & Nguyen-Van, P. (2020). Environmental convergence and environmental Kuznets curve: A unified empirical framework. *Ecological Modelling*, *437*, 109289.

Lee, J., Yucel, A. G., & Islam, M. T. (2023). Convergence of CO^2 emissions in OECD countries. *Sustainable Technology and Entrepreneurship*, *2*(1), 100029.

Li, N., Shang, L., Yu, Z., & Jiang, Y. (2020). Estimation of agricultural greenhouse gases emission in interprovincial regions of China during 1996–2014. *Natural Hazards*, *100*(3), 1037-1058.

Lima, M. A., Mendes, L. F. R., Mothé, G. A., Linhares, F. G., de Castro, M. P. P., Da Silva, M. G., & Sthel, M. S. (2020). Renewable energy in reducing greenhouse gas emissions: Reaching the goals of the Paris agreement in Brazil. *Environmental Development*, *33*, 100504.

Liu, D., Zhu, X., & Wang, Y. (2021). China's agricultural green total factor productivity based on carbon emission: an analysis of evolution trend and influencing factors. *Journal of Cleaner Production*, *278*, 123692.

Mahmood, H., Maalel, N., & Zarrad, O. (2019). Trade openness and CO^2 emissions: Evidence from Tunisia. *Sustainability*, *11*(12), 3295.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The quarterly journal of economics*, *107*(2), 407-437.

Martinelli, L. A., Coletta, L. D., Lins, S. R. M., Mardegan, S. F., & de Castro Victoria, D. (2016). Brazilian agriculture and its sustainability. *International food law and policy*, 767-792.

Martinelli, L. A., Naylor, R., Vitousek, P. M., & Moutinho, P. (2010). Agriculture in Brazil: impacts, costs, and opportunities for a sustainable future. *Current Opinion in Environmental Sustainability*, *2*(5-6), 431-438.

Melo Benites, V., Schaefer, C. E., Machado, P. L. O., Polidoro, J. C., & da Silva Teixeira, R. (2023). Insights into Brazilian Soils and Sustainable Agriculture Scenarios. *The Soils of Brazil*, 471-486.

Meng, J., Mi, Z., Guan, D., Li, J., Tao, S., Li, Y., ... & Davis, S. J. (2018). The rise of South–South trade and its effect on global CO^2 emissions. *Nature communications*, *9*(1), 1871.

Morales-Lage, R., Bengochea-Morancho, A., Camarero, M., & Martínez-Zarzoso, I. (2019). Club convergence of sectoral CO^2 emissions in the European Union. *Energy Policy*, *135*, 111019.

Oliveira, G., & Bourscheidt, D. M. (2017). Multi-sectorial convergence in greenhouse gas emissions. *Journal of environmental management*, *196*, 402-410.

Oliveira, T. D., Gurgel, A. C., & Tonry, S. (2019). International market mechanisms under the Paris Agreement: A cooperation between Brazil and Europe. *Energy policy*, *129*, 397-409.

Panopoulou, E., & Pantelidis, T. (2009). Club convergence in carbon dioxide emissions. *Environmental and Resource Economics*, *44*, 47-70.

Paramati, S. R., Mo, D., & Gupta, R. (2017). The effects of stock market growth and renewable energy use on CO^2 emissions: evidence from G20 countries. *Energy economics*, *66*, 360-371.

Payne, J. E. (2020). The convergence of carbon dioxide emissions: a survey of the empirical literature. *Journal of Economic Studies*, *47*(7), 1757-1785.

Pereira, P. A. A., Martha, G. B., Santana, C. A., & Alves, E. (2012). The development of Brazilian agriculture: future technological challenges and opportunities. *Agriculture & Food Security*, *1*, 1-12.

Pettersson, F., Maddison, D., Acar, S., & Söderholm, P. (2014). Convergence of Carbon Dioxide Emissions: A Review of the Literature. *International Review of Environmental and Resource Economics*, *7*(2), 141-178.

Phillips, P. C., & Sul, D. (2007). Transition modeling and econometric convergence tests. *Econometrica*, *75*(6), 1771-1855.

Phillips, P. C., & Sul, D. (2009). Economic transition and growth. *Journal of applied econometrics*, *24*(7), 1153-1185.

Prastiyo, S. E., Irham, Hardyastuti, S., & Jamhari, F. (2020). How agriculture, manufacture, and urbanization induced carbon emission? The case of Indonesia. *Environmental Science and Pollution Research*, *27*(33), 42092-42103.

Quah, D. T. (1996). Empirics for economic growth and convergence. *European economic review*, *40*(6), 1353-1375.

Raihan, A., & Tuspekova, A. (2022). Dynamic impacts of economic growth, energy use, urbanization, agricultural productivity, and forested area on carbon emissions: New insights from Kazakhstan. *World Development Sustainability*, *1*, 100019.

Ridzuan, N. H. A. M., Marwan, N. F., Khalid, N., Ali, M. H., & Tseng, M. L. (2020). Effects of agriculture, renewable energy, and economic growth on carbon dioxide emissions: Evidence of the environmental Kuznets curve. *Resources, Conservation and Recycling*, *160*, 104879.

Runar, B., Amin, K., & Patrik, S. (2017). Convergence in carbon dioxide emissions and the role of growth and institutions: a parametric and non-parametric analysis. *Environmental Economics and Policy Studies*, *19*, 359-390.

Salahuddin, M., Alam, K., Ozturk, I., & Sohag, K. (2018). The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO^2 emissions in Kuwait. *Renewable and sustainable energy reviews*, *81*, 2002-2010.

Sarkodie, S. A., & Strezov, V. (2019). A review on environmental Kuznets curve hypothesis using bibliometric and meta-analysis. *Science of the total environment*, *649*, 128-145.

Schnurbus, J., Haupt, H., & Meier, V. (2017). Economic transition and growth: a replication. *Journal of Applied Econometrics*, *32*(5), 1039-1042.

Shahbaz, M., & Sinha, A. (2019). Environmental Kuznets curve for CO^2 emissions: a literature survey. *Journal of Economic Studies*, *46*(1), 106-168.

Sofi, A. A., & Durai, S. R. S. (2016). Income convergence in India: a nonparametric approach. *Economic Change and Restructuring*, *49*, 23-40.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, *70*(1), 65-94.

Solow, R. M. (1957). Technical change and the aggregate production function. *The review of Economics and Statistics*, *39*(3), 312-320.

Wu, H., Huang, H., Tang, J., Chen, W., & He, Y. (2019). Net greenhouse gas emissions from agriculture in China: Estimation, spatial correlation and convergence. *Sustainability*, *11*(18), 4817.

Wu, J., Wu, Y., Guo, X., & Cheong, T. S. (2016). Convergence of carbon dioxide emissions in Chinese cities: a continuous dynamic distribution approach. *Energy Policy*, *91*, 207-219.

Xu, B., & Lin, B. (2017). Factors affecting CO^2 emissions in China's agriculture sector: Evidence from geographically weighted regression model. *Energy Policy*, *104*, 404-414.

Yu, S., Hu, X., Fan, J. L., & Cheng, J. (2018). Convergence of carbon emissions intensity across Chinese industrial sectors. *Journal of Cleaner Production*, *194*, 179-192.

Zhao, X., Burnett, J. W., & Lacombe, D. J. (2015). Province-level convergence of China's carbon dioxide emissions. *Applied Energy*, *150*, 286-295.

Zhu, J., & Lin, B. (2020). Convergence analysis of city-level energy intensity in China. *Energy Policy*, *139*, 111357.

Zilli, M., Scarabello, M., Soterroni, A. C., Valin, H., Mosnier, A., Leclere, D., ... & Ramos, F. M. (2020). The impact of climate change on Brazil's agriculture. *Science of the Total Environment*, *740*, 139384.

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APPENDIX A

Table A1. Description of state-level data panel, 1975-2019

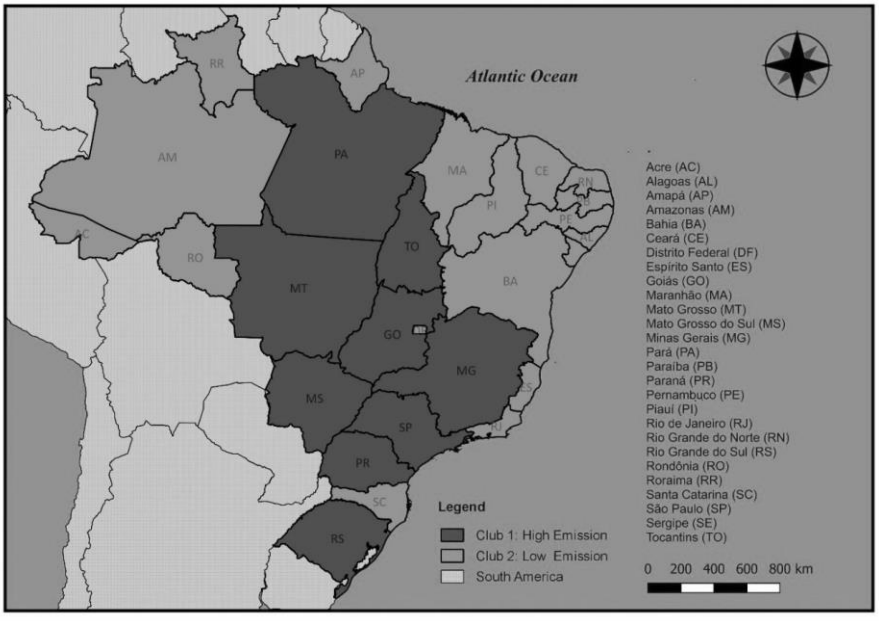
#	Description	Source
1	**Carbon Emissions:** CO^2 emissions from agriculture (managed soils) thousand tons.	SEEG
2	**Rural Capital:** Ratio of the number of tractors to the cultivation area.	IPEA - IBGE
3	**Rural Labour:** Ratio of the number of people employed in the rural sector to the cultivation area.	IPEA - IBGE
4	**Livestock Density:** Bovine herd per km^2.	PPM -IBGE
5	**Agricultural Production:** Value of agricultural production in thousand Brazilian reais at 2010 prices.	IPEA - IBGE
6	**Energy Consumption:** Electric energy consumption (MWh).	IPEA-MME
7	**Industrial Production:** Value added of industrial production in thousand Brazilian reais at 2010 prices.	IPEA - IBGE
8	**Rural Credit:** Flow of rural credit in thousand Brazilian reais.	BACEN
9	**Land Use:** Ratio of total harvested area to territorial area (%).	IPEA - IBGE

Source: Prepared by the authors.

Notes: Table A1 presents the description of the variables used in the convergence analysis and in the estimation of the Probit model. The variables from (1) to (8) are used in natural logarithm in econometric analysis.

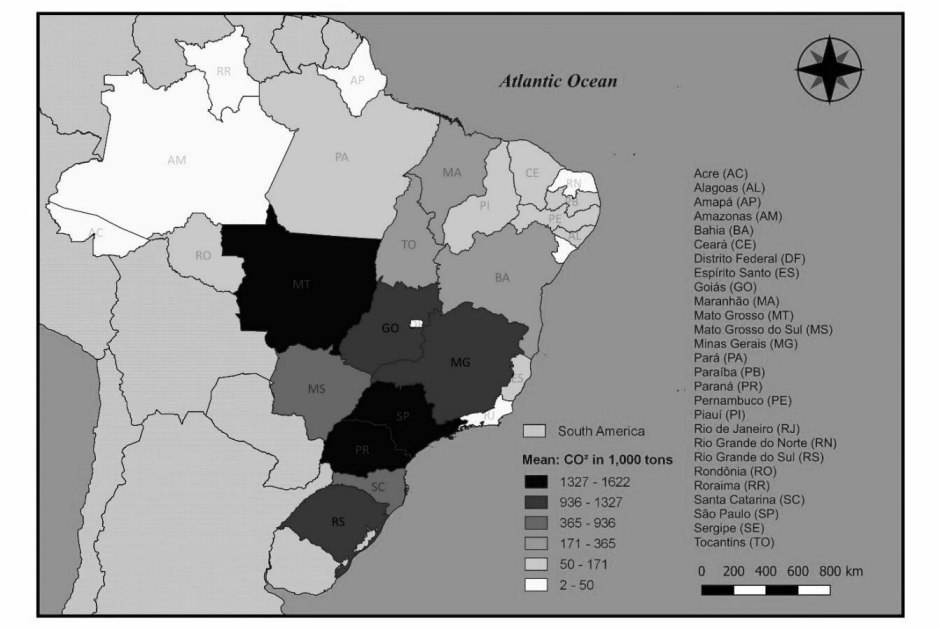
APPENDIX B

Fig. B1 Spatial distribution of convergence clubs in CO^2 emissions in agriculture



Source: Prepared by the authors, with data from the SEEG.

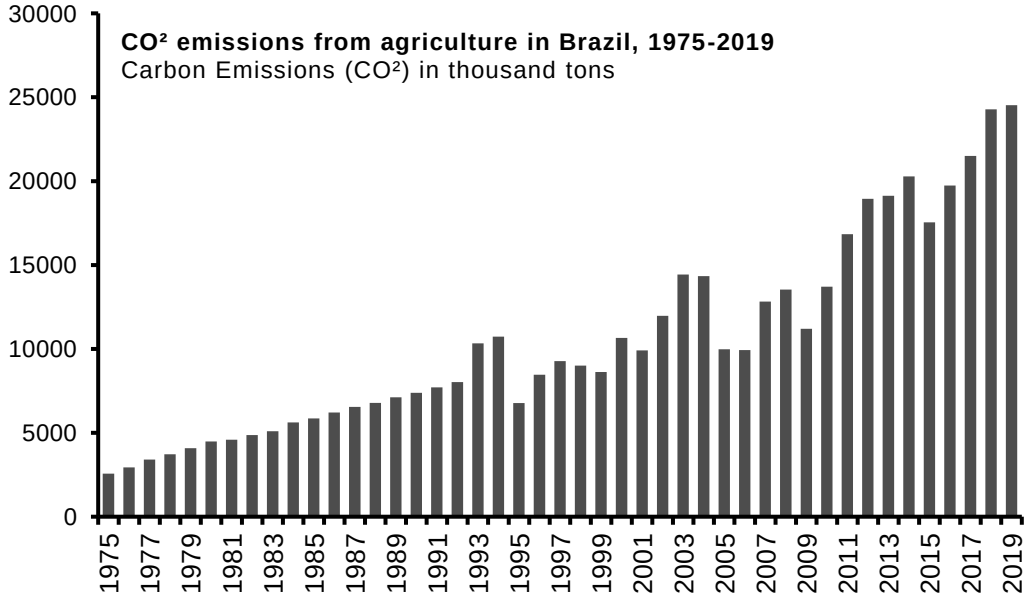
Fig. B2 Average CO² emissions from agriculture in Brazil



Source: Prepared by the authors, with data from the SEEG.

APPENDIX C

Fig. C1 Trends in CO² emissions from agriculture (managed soils) in Brazil



Source: Prepared by the authors, with data from the SEEG.

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Impacto do Programa de Desenvolvimento Rural do Continente na Instalação de Jovens Agricultores no Norte de Portugal

Impact of the Continente Rural Development Program on the Installation of Young Farmers in the North of Portugal

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Resumo

A renovação geracional e o ingresso de jovens agricultores na atividade são condições indispensáveis para a dinamização do setor agrário e dos territórios rurais, sendo um dos temas mais abordados nas Políticas Agrícolas ao longo do tempo.

Este estudo teve como objetivo analisar o impacto da ação 3.1, «Jovens Agricultores», do Programa de Desenvolvimento Rural do Continente, na instalação de jovens agricultores no Norte de Portugal, entre 2016 e 2018.

Foram inquiridos 203 jovens agricultores que desenvolviam, no seu todo, 44 atividades agrícolas distintas, numa estratificação da população com 259 grupos diferenciados por localização, valor de investimento validado e setor de atividade.

A maioria dos inquiridos mostrou-se «insatisfeita» ou «muito insatisfeita» com a produção obtida e com a rentabilidade das suas explorações face ao esperado. Depois da data do termo da operação, a esmagadora maioria dos inquiridos tencionava manter a atividade agrícola, embora com menor área e/ou efetivo animal.

A bovinicultura e a castanha foram as atividades agrícolas mais fiáveis, contrariamente aos espargos, cogumelos, helicicultura, apicultura e maracujá.

As propostas de melhoria no apoio à instalação de jovens agricultores mais destacadas foram o acompanhamento técnico e a certificação dos consultores. Além disso, foi frequentemente mencionada a sugestão de antecipar a formação obrigatória.

Palavras-chave: Jovens Agricultores, Investimentos, Renovação Geracional, Desenvolvimento Regional Agrário, PDR2020

Códigos JEL: J18; O13; Q18

Abstract

Generational renewal and the entry of young farmers into the activity are indispensable conditions for boosting the agrarian sector and rural territories and remain among the most discussed topics in agricultural policy.

The objective of this study was to analyse the impact of Action 3.1, "Young Farmers," of the Rural Development Program for Mainland Portugal, on the establishment of young farmers in the Northern region of Portugal between 2016 and 2018.

203 young farmers were interviewed, practicing a total of 44 different agricultural activities, in a stratification of the population with 259 groups differentiated by location, validated investment value and sector of activity.

The majority of respondents were “dissatisfied” or “very dissatisfied” with the production achieved and the profitability of their farms compared to expectations. The vast majority of respondents intended to continue farming after the end of the measure, albeit with a smaller area and/or animal population.

Cattle farming and chestnuts were the most reliable agricultural activities, in contrast to asparagus, mushrooms, heliciculture, beekeeping and passion fruit.

Technical monitoring and certification of advisors were the main suggestions for improving support for setting up young farmers, with the suggestion of bringing forward mandatory training also being frequently mentioned.

Keywords: Young Farmers, Investments, Generational Renewal, Regional Agricultural Development, PDR2020

JEL codes: J18; O13; Q18

1. INTRODUÇÃO

Com a entrada de Portugal na Comunidade Económica Europeia (CEE) em 1985, o país passou a dispor de apoios para a renovação geracional e a instalação de novos (jovens) agricultores, condições indispensáveis para a dinamização e inovação do setor agrário e dos territórios rurais. Os jovens agricultores, partindo do pressuposto que possuem maior competência técnica e capacidade empresarial, têm o potencial para promover a criação de novos produtos e serviços, introduzir novas práticas agrícolas e de gestão com impacto na produtividade e competitividade do setor (Ilhéu, 2014).

Este trabalho, focado na região Norte de Portugal por se tratar da área geográfica com maior número de jovens agricultores, teve como objetivo estudar o impacto da ação 3.1, «Jovens Agricultores», do Programa de Desenvolvimento Rural do Continente (PDR2020), na instalação de jovens agricultores entre 2016 e 2018.

A ação 3.1, «jovens agricultores», integrada na medida nº 3, «valorização da produção agrícola», da área n.º 2, «competividade e organização da produção», do PDR2020, foi dotada na sua programação, de uma despesa pública total de 265,5 milhões de euros (PDR, 2024a), que englobava as operações «3.1.1 – jovens agricultores» (prémio) com 134,5 milhões de euros, «3.1.2 - investimento de jovens agricultores na exploração agrícola» com 123,5 milhões de euros e «3.1.3 - investimento de jovens agricultores na exploração agrícola» apoiado por um instrumento financeiro com 7,4 milhões de euros.

A ação 3.1, «jovens agricultores» tem por objetivos: *i.)* fomentar a renovação e o rejuvenescimento das empresas agrícolas; *ii.)* aumentar a atratividade do sector agrícola aos jovens investidores, promovendo o investimento, o apoio à aquisição de terras, a transferência de conhecimentos e a participação no mercado *iii.)* reforçar a viabilidade e a competitividade das explorações agrícolas, promovendo a inovação, a gestão sustentável, a capacitação organizacional e o redimensionamento das empresas; *iv.)* preservar e melhorar o ambiente, assegurando a compatibilidade dos investimentos com as normas ambientais e de higiene e segurança no trabalho (Portaria nº328-C/2021).

O jovem agricultor tem de possuir ou obter formação e comprometer-se a executar um Plano Empresarial (PE), com a duração de cinco anos, que deve incorporar os seguintes elementos e condições: descrição da situação inicial; demonstração do potencial de produção agrícola; indicação das etapas e metas; coerência técnica, económica e financeira; ajudas anteriores à apresentação da candidatura e descrição dos investimentos a realizar. O apoio consiste na atribuição de um prémio aos jovens agricultores (incentivo não reembolsável), que é associado ao PE. Os investimentos que constituem o PE poderão envolver, nomeadamente: a aquisição e instalação de máquinas e

equipamentos; edificação de construções; melhoramentos fundiários; plantações; viveiros e sistemas de rega, recorrendo à operação «3.1.2 – investimento de jovens agricultores na exploração agrícola» que se destina a apoiar sob a forma de subsídio não reembolsável esses investimentos, enquanto a operação «3.1.1 – jovens agricultores» se destina a atribuir um prémio à instalação do jovem agricultor.

Este trabalho está estruturado em três partes principais. A primeira parte consiste no enquadramento do tema, com uma revisão da literatura com vista à apresentação de análises de evolução temporal e indicadores ao longo dos vários Quadros Comunitários de Apoio (QCA), focando-se principalmente na avaliação e análise crítica dos apoios à instalação dos jovens agricultores. Na segunda parte, é apresentada a metodologia, incluindo a descrição da seleção da amostra e o tratamento dos dados obtidos. Por fim, na terceira parte, são apresentados os resultados, seguidos da sua análise e discussão.

2. Instalação de Jovens Agricultores como Política Pública para a Inovação e Revitalização das Áreas Rurais

O apoio à instalação de jovens agricultores tem sido uma constante prioridade dos Governos. Antes da adesão de Portugal à CEE, em 1979, foi instituído o "regime de instalação do jovem agricultor" através do Decreto-Lei n.º 513-E/79 (Ilhéu, 2014).

Contudo, os apoios financeiros passaram a ser mais consistentes após a adesão à CEE, existindo diversas medidas/ações/operações com vista ao rejuvenescimento dos produtores agrícolas (Quadro 1). Desde 1986 existiram cinco programas (797, PAMAF, AGRO, ProDer e o PDR2020) que aprovaram cerca de 35.151 candidaturas (1986-2022). Em novembro de 2024 arrancam os novos apoios para jovens no PEPAC, que se prolongarão até 2027 e onde está contemplada uma dotação de 225 milhões de euros.

Quadro 1 – Evolução dos apoios à instalação e investimento de jovens agricultores

Quadro Comunitário de Apoio (QCA)	Período	Dotação programada (milhões de euros)	Programa	Projetos aprovados (nº)	Projetos na região Norte (%)
I	1986-1993		797	11.958	42
II	1994-1999		PAMAF	4.861	53
III	2000-2006		AGRO	4.374	54
IV	2007-2013	212,5	ProDer	8.314	47
V	2014-2022	265,5	PDR2020	5.644[1]	47
VI	2023-2027	225,0	PEPAC	-	-

Fonte: Ilhéu, (2014) e PDR (2024b)

No ProDeR (ProDeR, 2013) numa análise entre 2008-2012 da ação «1.1.3 - instalação de jovens agricultores» a idade média nacional dos jovens agricultores era de 30 anos, sendo a média do total de agricultores de 62 anos.

Veras, N. (2022) refere que até ao primeiro trimestre de 2022 foram afetos 276 milhões de euros aos 13 anúncios da operação «3.1.1 – jovens agricultores». Por outro lado, 29%, dos projetos aprovados eram referentes a jovens agricultores representando metade da despesa pública atribuída à componente investimento (excluindo os prémios), num investimento médio de 263 mil euros e um apoio médio de 103 mil euros por projeto.

Moura (2023) numa avaliação do apoio aos jovens agricultores durante o PDR2020, comparou indicadores de dimensão física, económica, produtividade e emprego entre jovens que receberam apoios do PDR2020, com jovens que não receberam apoios, mas eram elegíveis e com jovens que não receberam apoios e não eram elegíveis. Neste sentido, os jovens que receberam apoios do PDR2020 apresentaram médias de Superfície Agrícola Utilizada (SAU) (35,6 ha), dimensão económica média (68.814 €), produtividade do trabalho (42.209 €/UTA), emprego criado

[1] Número de operações contratadas na operação «3.1.1 – jovens agricultores» no balanço de 30 de abril de 2024 (PDR, 2024b).

(1,53 UTA/exploração) e peso de escolaridade secundário/superior (100%) mais elevados que os outros grupos de jovens. Por outro lado, apresentaram um menor peso do trabalho familiar (38%).

A Comissão Europeia (2015) avaliou as necessidades dos jovens agricultores europeus através de 2.205 inquéritos, em 28 Estados-Membros, concluindo que, em termos gerais, a disponibilidade de terra (para compra ou arrendamento) é a sua maior necessidade. Os subsídios, acesso ao crédito e a existência de mão-de-obra qualificada são, do ponto de vista geral, aspetos também importantes. Sobre as necessidades de formação, os jovens agricultores europeus estão interessados em obter conhecimento sobre tecnologia necessária às suas explorações e sobre estratégias de gestão. São também importantes aspetos associados ao marketing, comunicação, finanças e gestão da empresa.

Nos indicadores de monitorização e execução financeira do PDR2020 (PDR, 2024b) apresentados no Quadro 2 destaca-se que o compromisso da operação 3.1.2 - investimento de jovens agricultores é de 125%. Contudo, a execução de despesa pública é de apenas 53%, ou seja, substancialmente abaixo da execução de despesa do programa, que era no final de abril de 2024 de 89%. Em suma, o pagamento dos prémios conseguiu executar-se com relativa facilidade (89% de execução da despesa pública). No entanto, no investimento (3.1.2) restam 88,5 milhões de euros por executar, sendo a sexta operação em setenta e uma com maior despesa por executar e a sétima em termos proporcionais com 57% da despesa pública contratada por executar. Isto indica que não se trata de um problema de falta de verbas para investimento, mas de execução financeira do mesmo.

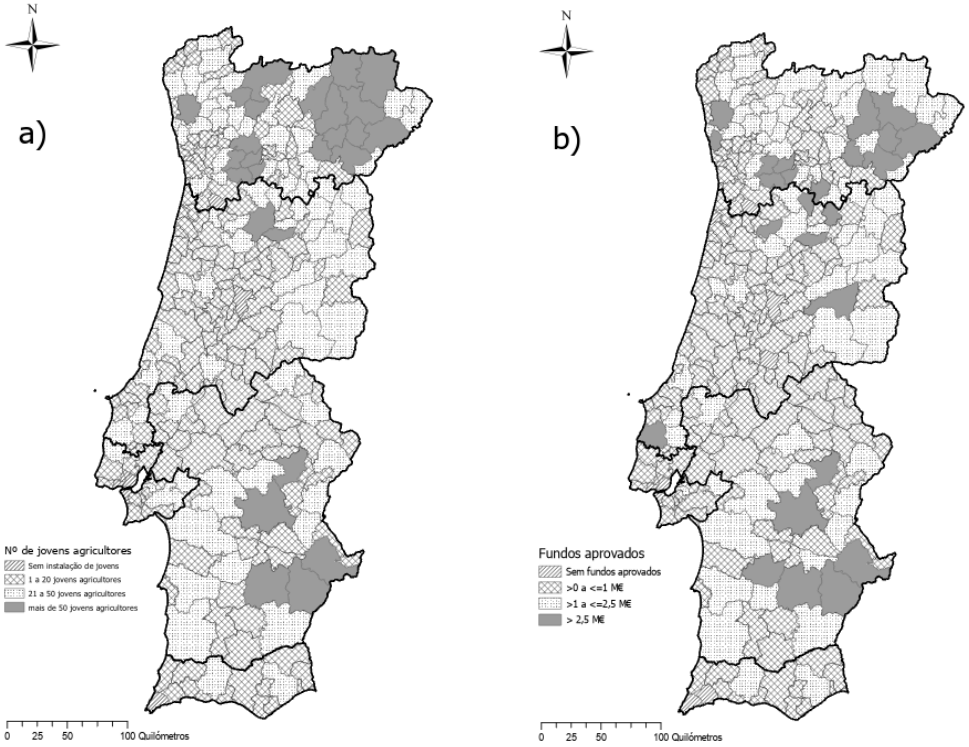
Quadro 2 – Indicadores de monitorização e execução financeira PDR2020

				Operações		
			PDR2020	**3.1.1**	**3.1.2**	**3.1.3**
Programação 2014-2022	DP	1	5.742.629	134.527	123.532	7.461
	FEADER	2	4.786.287	118.875	100.713	6.900
Compromissos assumidos	Nº	3	478.314	5.239	1.859	0
	DP	4	6.482.699	130.744	155.004	7.461
	FEADER	5	5.390.657	115.435	126.342	6.900
Despesa contratada	Nº	6	477.826	5.202	1.834	0
	DP	7	6.616.552	132.260	154.196	7.461
	FEADER	8	5.492.019	115.142	125.308	6.900
Pagamentos aos beneficiários	DP	9	5.119.670	120.088	65.612	5.596
	FEADER	10	4.286.540	106.245	51.645	5.166
Taxa de compromisso 2014-2022	DP	11=4/1	113%	97%	125%	100%
	FEADER	12=5/2	113%	97%	125%	100%
Taxa de execução 2014-2022	DP	13=9/1	89%	89%	53%	75%
	FEADER	14=10/2	90%	89%	51%	75%

Fonte: PDR (2024b), DP – Despesa Pública (euros), valores em milhares de euros.

À semelhança do que aconteceu em todos os programas de apoio à agricultura, também no PDR2020 a região Norte (Figura 1) foi onde se instalaram mais jovens agricultores (47%) e onde o apoio aprovado foi maior, com cerca de 113,9 milhões de euros (45%). Na região Norte, destaca-se a NUTS III Terras de Trás-os-Montes que concentra no país o maior número de jovens e de apoio aprovado.

Figura 1 – Distribuição do número de jovens agricultores (a) e apoio concedido (b) através das operações 3.1.1 e 3.1.2



Fonte: PDR (2024b), elaboração própria.

Apesar de em todos os QCA existirem medidas para promover o rejuvenescimento do tecido empresarial, o regime de apoio à instalação de jovens agricultores, até 2009, não conseguiu inverter a tendência de queda acentuada do número de jovens agricultores (Ilhéu, 2014). Porém, os dados do recenseamento agrícola de 2019 (INE, 2024) demonstram o impacto do ProDer e PDR2020 com uma inflexão da trajetória decrescente de produtores singulares com idade inferior aos 34 anos.

O Quadro 3 ilustra essa reversão, podendo verificar-se que entre 2009 e 2019, em todas as NUTS II de Portugal continental, o número de agricultores singulares (<34 anos) aumentou em termos absolutos e em percentagem do total de agricultores. Este fato é ainda mais animador quando o número de produtores agrícolas total diminuiu nessa mesma década.

Quadro 3 – Produtores agrícolas singulares com menos de 34 anos.

		1989	1999	2009	2019
Norte	Total (nº)	191.025	135.688	108.912	105.349
	15 - 34 anos (nº)	14.724	5.991	2.564	2.749
	%	7,7%	4,4%	2,4%	2,6%
Centro	Total (nº)	240.876	160.823	103.303	93.541
	15 - 34 anos (nº)	14.171	4.984	1.428	2.099
	%	5,9%	3,1%	1,4%	2,2%
Área Metropolitana de Lisboa	Total (nº)	19.241	11.770	7.204	5.784
	15 - 34 anos (nº)	1.100	507	144	183
	%	5,7%	4,3%	2,0%	3,2%
Alentejo	Total (nº)	69.046	49.001	38.935	33.811
	15 - 34 anos (nº)	4.135	2.269	1.042	1.326
	%	6,0%	4,6%	2,7%	3,9%
Algarve	Total (nº)	25.881	18.656	12.153	12.130
	15 - 34 anos (nº)	810	417	149	252
	%	3,1%	2,2%	1,2%	2,1%
Continente	Total (nº)	546.069	375.938	270.507	250.615
	15 - 34 anos (nº)	34.940	14.168	5.327	6.609
	%	6,4%	3,8%	2,0%	2,6%

Fonte: INE, Estatísticas agrícolas de base (1989-2019).

Mateus (2022) realizou uma caraterização socioeconómica dos jovens agricultores em Portugal continental, salientando a sua melhor preparação em formação na área agrícola e académica, uma dimensão física (em média) superior às restantes explorações agrícolas, quer em área, quer em número de animais, explorações economicamente mais viáveis e com mais tecnologia, utilizando com maior frequência sistemas de produção mais sustentáveis.

Para Cunha (2021) os resultados insatisfatórios no rejuvenescimento dos produtores agrícolas derivam de uma gestão um pouco errática, imprevisível e inconstante das medidas e dos procedimentos. É disto exemplo a alternância de períodos de extremo facilitismo com longos períodos de ausência de abertura de avisos, da gestão orientada para a dimensão financeira e política em vez de orientada para resultados de eficiência, da ausência de um pacote adequado de medidas à disposição dos jovens agricultores para responder a questões que lhes são importantes, como o acesso à terra, o acesso ao crédito e o acompanhamento técnico e de gestão.

Como propostas para o atual período de execução de fundos (2023-2027), Cunha (2021) apontou que para os jovens agricultores deveria existir um programa financeiramente mais robusto, tornando elegível a compra de terras, com melhoria do esforço de informação, formação e aconselhamento, de forma a não criar falsas expectativas aos que pretendem instalar-se como jovens agricultores. Neste âmbito, os apoios do PEPAC para os jovens deveriam responder aa cinco preocupações: i) incluir além do apoio a fundo perdido o acesso a crédito garantido e gratuito para colmatar as dificuldades de financiamento; ii) obrigar à existência de um técnico credenciado de acompanhamento para os 5 anos de instalação ou até ao ano cruzeiro; iii) obrigar a entregar um relatório de acompanhamento a cada pedido de pagamento, iv) assegurar que o técnico credenciado realiza visitas de acompanhamento à exploração; e v) assegurar que o jovem está integrado numa organização de produtores ou dispõe de contratos de comercialização.

Oliveira e Carvalho (2021), numa avaliação do efeito de políticas agrícolas entre 2005 e 2016, nas quais se inclui a instalação de jovens agricultores, concluíram que a mortalidade das explorações de jovens agricultores é superior às restantes.

Guerra e Lopes (2022), num trabalho sobre o papel dos apoios comunitários aos jovens agricultores como impulsionador de inovação na região de Trás-os-Montes, salientam que os jovens instalados no ProDer (2007-2013) tiveram o potencial de trazer mudança e travar o envelhecimento nas áreas rurais. Neste trabalho, com a inquirição de 72 agricultores, 52 dos quais na região de Trás-os-Montes, concluíram que a modernização do setor, liderança e proatividade associativa são favorecidas com os apoios comunitários à instalação de jovens.

É oportuno apresentar os quinze importantes conselhos que o antigo ministro da Agricultura, do Desenvolvimento Rural e das Pescas do XV Governo Constitucional, Professor Sevinate Pinto, deixou aos futuros agricultores, identificando os aspetos fundamentais que devem ser considerados durante a instalação como jovens agricultores para assegurar o sucesso (Pinto, 2014).

O conhecimento do enquadramento legal e a procura de aconselhamento especializado (1), o estabelecimento de uma folga de autofinanciamento entre 20 e 40% do valor do projeto (2), o ajuste técnico das atividades agrícolas às condições do terreno (3), o conhecimento dos mercados agrícolas, evolução e volatilidade dos preços e canais de escoamento (4), o planeamento e a análise de possíveis cenários empresariais (5), a análise sobre o fornecimento de serviços externos em vez de adquirir equipamentos (6), não subestimar os custos de mão-de-obra e verificar se existe disponível na região (7), a escolha de uma natureza jurídica da exploração adequada ao caso (8), esperar imprevistos e estabelecer uma reserva financeira (9), ter dados mais reais possíveis no plano empresarial (10), ter alguma modéstia nos gastos e salários do gestor (11), não iniciar o projeto antes da aprovação (12), estabelecer prioridades nos investimentos (13), fazer uma boa gestão de tesouraria nos reembolsos dos apoios (14), estabelecer uma boa contabilidade de gestão pessoal devido ao ciclo produtivo das culturas (15).

Gonçalves (2019), numa investigação sobre o investimento de jovens agricultores em agricultura biológica, através de entrevistas a estudos de caso, salienta que, a execução das candidaturas é substancialmente diferente do inicialmente planeado, destacando contingências orçamentais provocadas por despesas imprevistas, sendo importante a gestão de tesouraria e o estabelecimento de uma reserva de capitais próprios.

Os jovens agricultores em agricultura biológica, segundo a avaliação de Gonçalves (2019), eram, no contexto nacional, em 2019, apenas 6% dos projetos instalados no PDR2020. Além das recomendações de conhecer o sistema de produção a desenvolver, contactos com outros

agricultores, com explorações semelhantes e com canais para escoamento dos produtos, Gonçalves (2019) aponta que o procedimento burocrático no processo de análise das candidaturas deveria ser mais célere e simplificado.

3. METODOLOGIA

Este estudo teve como objetivo analisar o impacto da ação 3.1, «Jovens Agricultores», do Programa de Desenvolvimento Rural do Continente (PDR 2020), na instalação de jovens agricultores no Norte de Portugal, entre 2016 e 2018.

Neste sentido, a abordagem metodológica assentou na realização de um inquérito, por telefone, assente num questionário.

O questionário, criado como instrumento de inquirição, incluiu os tópicos:

1. Motivações para a instalação como jovem agricultor.
2. Fontes de informação determinantes da escolha da principal atividade da exploração.
3. Apoio técnico no arranque da atividade da exploração e grau de satisfação.
4. Problemas na execução física dos investimentos.
5. Grau de satisfação quanto às produções, custos de manutenção e proveitos.
6. Continuidade da exploração, após a data do termo da operação.

A avaliação do grau de satisfação foi efetuada através da escala de *Likert*, uma escala ordinal que varia de 1 a 5: 1 - Muito insatisfeito; 2 - Insatisfeito; 3 - Nem insatisfeito, nem satisfeito; 4 - Satisfeito; 5 - Muito satisfeito.

A população, 1.078 projetos de investimento, foi constituída por operações com Pedidos de Pagamento (PP) submetidos de 2016 a 2018, no âmbito da operação «3.1.1 - jovens agricultores», «3.1.2 – investimento de jovens agricultores na exploração agrícola» ou «3.2.1 - investimento na exploração agrícola» (referente a jovem agricultor). Esta população contempla pessoas singulares e coletivas que submeteram candidaturas desde fevereiro de 2014, envolvendo um amplo leque de atividades agrícolas.

O estudo incidiu nas operações com pedidos de pagamento submetidos há mais tempo, na expetativa de permitir selecionar as que detinham um percurso funcional suficientemente extenso, condição indispensável para se poderem auscultar os resultados produtivos e económicos.

a. Seleção da amostra

A amostra foi selecionada com base no método da amostragem aleatória estratificada. Com a utilização deste método procurou-se garantir que diferentes subgrupos (estratos) da população fossem representados na amostra de forma proporcional ao seu peso na população correspondente. Para assegurar a representatividade da amostra, face às 1.078 operações, foram criados 259 estratos, a partir da combinação das seguintes variáveis:

1. Classe de investimento elegível validado para prémio – 1 - [35 484€ - 75 484€]; 2 -]75 484€ - 115 484€]; 3 -]115 484€ - 195 484€] e 4 - > 195 484€;

2. Setor/tipologia - 1 - Apicultura; 2 - Avicultura; 3 - Bovinicultura; 4 - Caprinicultura; 5 – Cultura de citrinos; 6 - Cultura de especiarias - plantas aromáticas - medicinais; 7 - Cultura de frutos de casca rija/frutos secos; 8 - Cultura de frutos tropicais e subtropicais; 9 - Cultura de outros frutos em árvores e arbustos; 10 - Cultura de pequenos frutos e bagas; 11 - Cultura de pomóideas e prunóideas; 12 - Cultura de produtos hortícolas - raízes e tubérculos; 13 - Cunicultura; 14 - Floricultura e cultura de plantas ornamentais; 15 - Helicicultura; 16 - Olivicultura; 17 - Outra produção animal; 18 - Outras culturas permanentes; 19 - Outras culturas temporárias; 20 - Ovinicultura; 21 - Suinicultura; 22 - Viticultura; 23 - Viveiros.

3. NUTS III: 1 - Alto Minho; 2 - Área Metropolitana do Porto; 3 - Alto Tâmega; 4 - Ave; 5 - Cávado; 6 - Douro; 7 - Tâmega e Sousa; 8 - Terras de Trás-os-Montes.

Para cada estrato foi calculada a sua proporção na população em estudo e a sua representatividade na amostra, no pressuposto de que seriam realizados 108 inquéritos (10% da população). Porém, face do reduzido número de operações integrado na maioria dos estratos, em que não haveria qualquer inquérito a realizar nesses casos, com a consequente perda de abrangência, foi realizado um arredondamento por excesso, quando o valor era inferior a 1 e por defeito, nas situações opostas.

Daqui resultou uma amostra compreendendo 273 operações, repartidas por 259 estratos, representando mais de 25% da população.

b. Amostra inquirida

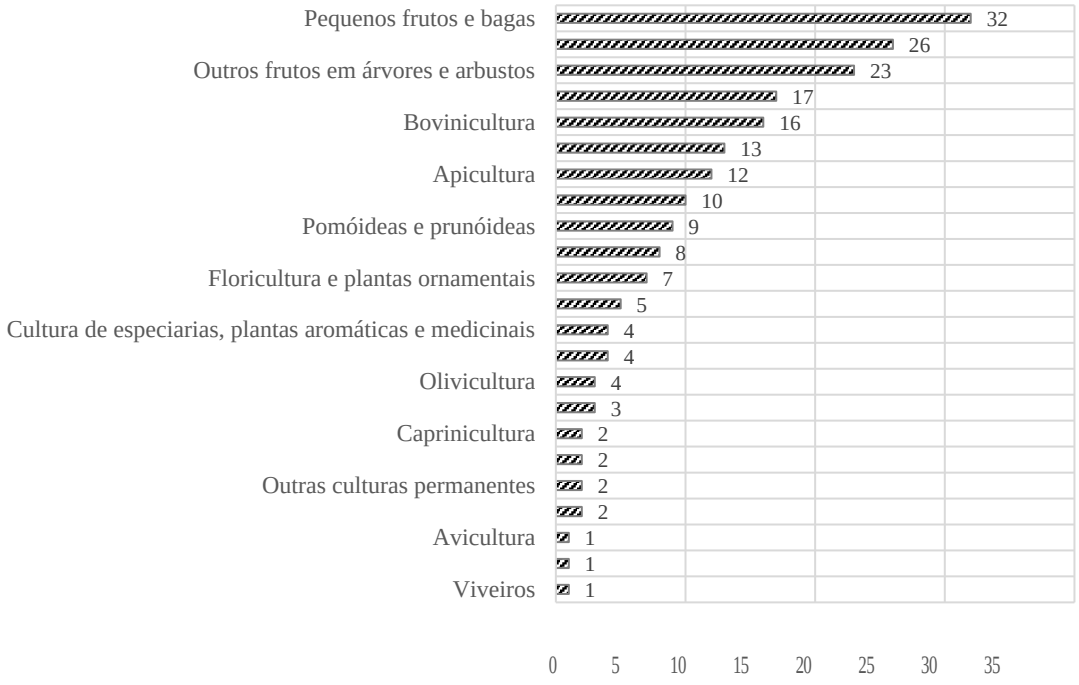
Após a seleção da amostra, as entrevistas foram realizadas pelo mesmo inquiridor, com uma duração média de 15 minutos. Foram efetuadas 203 entrevistas, face às 273 previstas, distribuídas por 189 estratos. Houve várias tentativas de realização de entrevistas que se tornaram infrutíferas devido ao contacto telefónico estar desativado, não havendo resposta ao contacto telefónico (nalguns casos, depois de ter sido previamente agendado) ou porque o jovem agricultor se encontrava no estrangeiro. Em consequência, 70 estratos ficaram sem qualquer operação passível de inquérito, perdendo a sua representação.

Cerca de 16% das operações passaram, entretanto, ao estado «Cancelado» ou «Decisão anulada - incumprimento prazo de início de execução» o que inviabilizou a entrevista.

Entre os 203 questionários realizados, 53 (26,1%) candidaturas foram submetidas em 2014, 145 (71,4%) em 2015 e 5 (2,5%) em 2016, sob enquadramento dos Avisos: 03/Ação 3.2/2015 + 01/Ação 3.1/2015; 04/Ação 3.2/2015 + 02/Ação 3.1/2015; 06/Ação 3.2/2015 + 03/Ação 3.1/2015.

Entre os 23 setores/tipologia incluídos no estudo (Figura 2), os mais representados (56) foram as culturas de pequenos frutos e bagas (32), as culturas de produtos hortícolas, raízes e tubérculos (26) as culturas de outros frutos em árvores e arbustos (23), as culturas de frutos de casca rija/frutos secos (17) e a bovinicultura (16).

Figura 2 – Distribuição dos inquéritos realizados por setor/tipologia



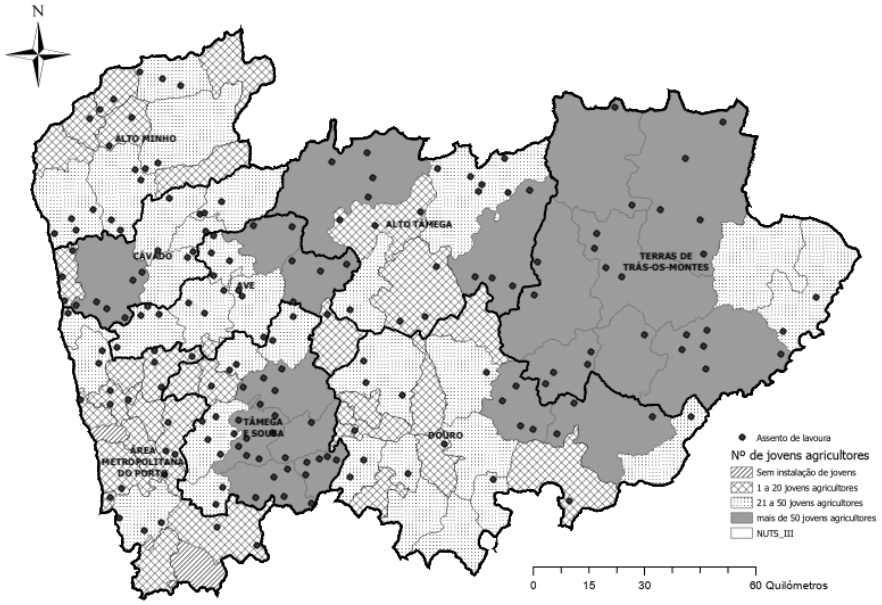
Foram identificadas 44 atividades, a grande maioria das quais culturas permanentes, cujo ciclo de produção requer alguns anos para atingir todo o seu potencial produtivo. Este facto, conjugado com a existência de uma única atividade agrícola geradora de receitas - na maioria das explorações - leva a acreditar que muitos dos jovens agricultores recorreram forçosamente a outras fontes de rendimento externas à agricultura.

A cultura de mirtilos, com 14,1% dos inquéritos, foi de longe a atividade mais representada neste estudo. Seguiram-se a helicicultura (6,9%), apicultura (6,4%) e cogumelos (6,4%), mas com menos de metade dos registos. Também são dignas de nota a cultura de kiwi (4,9%), castanha (4,9%), bovinicultura (carne) (4,3%), bovinicultura (leite) (4,9%), espargo (4,9%), viticultura (4,9%), amêndoa (2,9%), framboesa (2,9%), kiwi arguta (2,4%), maracujá (2,4%) e cereja (2,4%).

O investimento elegível validado para efeitos de prémio oscilou, em 60% das candidaturas, entre 75.484€ e 195.484€. Mas foi a classe de investimento entre os 75.484€ e 115.484€ a mais representada, com 32% dos inquéritos. De realçar que a classe de investimento > 195.484€ conta com 20% dos registos, em situação de igualdade com a classe de valor mais modesto (até 75.484€).

A sub-região Tâmega e Sousa (Figura 3) assume uma posição de destaque na concentração de inquéritos (19%), seguida da Terras de Trás-os-Montes (15%). Inversamente, Alto Minho e Cávado, representam somente 10% das candidaturas estudadas.

Figura 3 – Distribuição geográfica dos jovens agricultores inquiridos



c. Tratamento de dados

Para o tratamento dos dados recolhidos foi construída uma base de dados com duas finalidades: reunir toda a informação quantitativa e qualitativa e recodificar as variáveis. A partir desta nova informação, foi criado um ficheiro em *software* SPSS (versão 28.0.1.1) para, numa primeira fase, se obter informação descritiva de todas as variáveis e, numa segunda fase, se proceder a uma análise estatística mais detalhada.

Foi realizado o Teste do Qui-Quadrado (χ^2) para verificar se dois ou mais grupos independentes diferiam relativamente a uma determinada caraterística. Isto é, se a frequência com que os elementos da amostra se repartiam pelas classes de uma variável nominal categorizada seria, ou não, idêntica.

Concretamente, avaliou-se se o alcance dos objetivos produtivos foi influenciado pelos seguintes fatores: 1. atividade principal; 2. apoio técnico no arranque da atividade da exploração; 3. classe de investimento; 4. localização da exploração (NUTS III).

Realizou-se um teste para avaliar se a Valia Global da Operação (VGO) seria, ou não, idêntica entre candidaturas que alcançaram *vs*. não alcançaram os objetivos. Efetuou-se, para este fim, uma análise de variância (ANOVA) a um fator (*one-way*), do tipo I. Nesse sentido e para se aumentar a potência dos testes realizados, as classes de observação (níveis dos fatores) utilizadas para medir o grau de satisfação quanto aos resultados produtivos e económicos foram limitadas a 2: 0, «não atingiu o objetivo» (nota 1 ou 2); 1, «atingiu o objetivo» (nota 3 a 5).

4. ANÁLISE E DISCUSSÃO

a. Enquadramento da instalação como Jovem Agricultor

O principal motivo para a instalação como jovem agricultor, com 40% das respostas, decorre da oportunidade de desenvolver uma atividade rentável, com apoio financeiro e na expetativa de rentabilizar um património fundiário (Figura 4).

Figura 4 – Primeiro motivo para a instalação como jovem agricultor

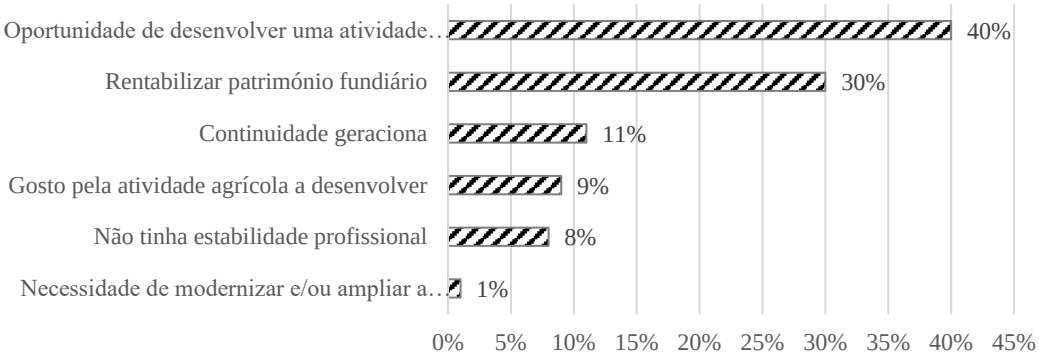
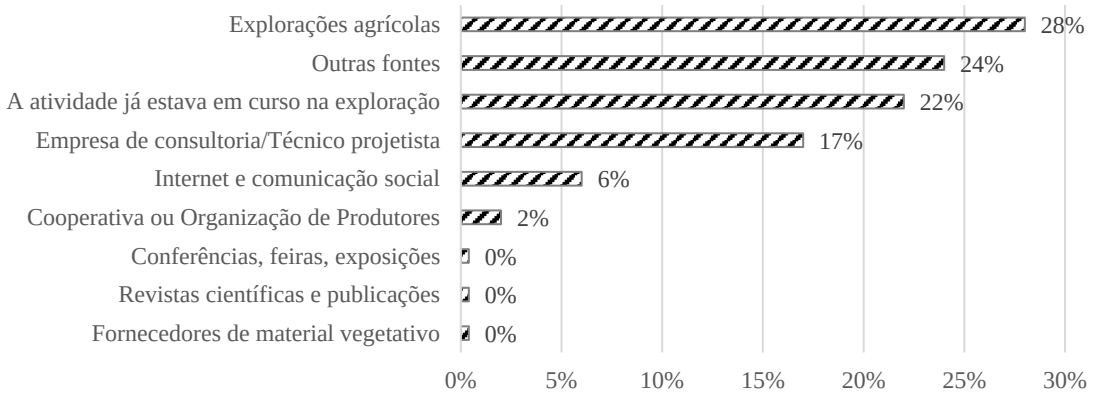


Figura 4 – Primeiro motivo para a instalação como jovem agricultor

Quando questionados sobre as fontes de informação que determinaram a escolha da atividade principal da exploração, 28% dos jovens agricultores declararam que foi o conhecimento de explorações agrícolas, enquanto 24% referiram a influência de outras fontes, sobretudo familiares ou amigos (Figura 5).

Figura 5 – Fonte de informação prioritária na escolha da atividade principal



Cerca de 58% dos inquiridos considera-se «satisfeito» ou «muito satisfeito» com a formação obrigatória realizada no âmbito das condicionantes à candidatura, não obstante ter sido frequentemente referido que os conteúdos eram genéricos.

Em 107 explorações (53%) houve apoio técnico na execução física dos investimentos e arranque do funcionamento das explorações, tendo sido maioritariamente prestado (47%) pela empresa de consultoria/técnico projetista. A contratação de um técnico especialista teve também alguma expressão (21%). Em ambas as opções, a larga maioria dos inquiridos (70%) considerou-se «satisfeito» ou «muito satisfeito» com a qualidade do serviço prestado.

b. Principais problemas na execução física dos investimentos

O cumprimento de requisitos administrativos (burocracia), com 29% das respostas, foi o problema que se fez sentir com maior acuidade na execução física dos investimentos, seguido da falta de liquidez (22%), de problemas com fornecedores de bens e serviços (21%) e do atraso no

processamento dos pedidos de pagamento (16%), estando este fator intimamente ligado à falta de liquidez.

Entre os constrangimentos relacionados com a burocracia, destacam-se: a dificuldade (ou mesmo impossibilidade) de adesão a uma Organização de Produtores (OP), pelas exigências impostas (custo e/ou produção mínima), como também pelo facto da OP ter perdido a homologação em data posterior à submissão da candidatura; dificuldades na obtenção de empréstimo bancário; morosidade na obtenção dos pareceres emitidos pelo Instituto da Conservação da Natureza e das Florestas (ICNF) e pelos municípios.

É importante sublinhar que, com exceção do documento de adesão à OP, todos os outros são exigidos em circunstâncias gerais, independentemente de haver lugar a financiamento, ou não. Ou seja, são exigências inultrapassáveis, porque são de caráter geral. Pelo contrário, o documento relativo à adesão a uma OP decorre da opção assinalada na candidatura (para aumentar a VGO). Ora, nalgumas situações, sabe-se que na época da submissão da candidatura não existia qualquer OP relacionada com as atividades do projeto de investimento.

Cerca de uma dezena de inquiridos queixou-se de longos períodos de espera (superiores a nove meses) pelo processamento dos pedidos de pagamento. Por outro lado, foram numerosos os beneficiários, alguns dos quais com elevadas habilitações académicas, que declararam terem tomado conhecimento das regras de pagamento das ajudas aos investimentos, em particular das condições de reembolso, na véspera de terem de realizar o primeiro investimento.

Outro facto digno de nota foi a morosidade na execução física dos investimentos. Alguns inquiridos ainda não tinham realizado qualquer colheita à data da inquirição. Esta situação resultou, essencialmente, da descapitalização. Ficou bem patente o endividamento a que a maioria dos jovens agricultores declarou ter de se sujeitar, para conseguir realizar o investimento e cobrir as despesas de manutenção. Esta informação contrasta nitidamente com a revelada nas candidaturas. De acordo com as informações registadas, a intenção de recorrer a capitais alheios (particularmente de instituições de crédito) era insignificante. O recurso a instituições de crédito foi assinalado pelos jovens agricultores somente em seis candidaturas. Não obstante este dado proceder de uma declaração do beneficiário («Comprometo-me com a veracidade das informações fornecidas ao Estado Português através deste formulário, sujeitando-me às sanções legalmente aplicáveis em caso contrário»), julga-se que muitos dos jovens agricultores não terão tomado conhecimento, ou não prestaram atenção a este detalhe. A verdade, porém, é que a dispensa de capitais alheios é inverosímil, como aliás se comprova pelas declarações prestadas no inquérito.

Num contexto em que existe endividamento, sem que os custos financeiros tenham sido incorporados no cálculo dos indicadores de rentabilidade empresarial (Valor Líquido Atualizado e Taxa Interna de Rentabilidade), gera-se uma sobreavaliação tácita destes indicadores, de que poderá resultar a aprovação de candidaturas economicamente inviáveis. Além disso, a hierarquização das candidaturas aprovadas (em função da VGO), poderá ser enviesada, penalizando os jovens agricultores que, ao contrário da generalidade, declaram aqueles custos financeiros.

c. Grau de satisfação quanto à produção e rentabilidade das atividades

A maioria dos inquiridos (60%) mostrou-se «insatisfeita» ou «muito insatisfeita» com a produção obtida (da principal atividade), aumentando aquele valor para 78%, no que respeita à rentabilidade. Os motivos para o sucedido derivam de «Outros motivos» e da ocorrência de condições climatéricas adversas.

Estes resultados comprometem seriamente a concretização dos objetivos da ação 3.1, visto não ser possível aumentar a atratividade do setor agrícola e rejuvenescer o setor sem resultados económicos animadores.

Se pudessem voltar atrás, 20% dos inquiridos declararam que não se teriam instalado como jovem agricultor, enquanto mais de 15% não teriam escolhido a mesma atividade principal. As atividades mais representadas na primeira situação foram a amora, cravo, maracujá e morango. Já no que respeita às atividades que os inquiridos não teriam escolhido, as visadas com maior relevância foram a amora, kiwi amarelo e kiwi arguta.

d. Continuidade da gestão da exploração, após a data do termo da operação

Quando confrontados com a possibilidade de cessarem a atividade, depois de atingida a data do termo da operação, a esmagadora maioria dos inquiridos (88%) declarou que tencionava manter a atividade da exploração, embora com menor área e/ou efetivo animal. Este resultado é surpreendente, tendo em conta os comentários de vários inquiridos, revelando que muitos jovens agricultores do seu conhecimento cessaram a atividade da exploração precocemente. O principal motivo apontado pelos que cessarão (ou já cessaram) a atividade consubstancia-se nos resultados económicos desfavoráveis.

Não obstante a Autoridade de Gestão do PDR2020 e o IFAP, I.P. enviarem periodicamente mensagens eletrónicas alertando para as datas de início dos investimentos e de termo da operação, foram vários os jovens agricultores que solicitaram no decurso das entrevistas a indicação da data de termo da operação.

e. Análises estatísticas

A atividade exercida teve influência no alcance dos objetivos produtivos (*p value*= 0,026 < α = 0,05). Ou seja, há atividades mais fiáveis em termos produtivos do que outras. Porém, não foi possível aplicar o teste do χ^2 com todo o rigor: é necessário N > 20; todos os $E_{ij} > 1$ e pelo menos 80% dos $E_{ij} \geq 5$. E, no nosso caso, a terceira condição não é satisfeita. Ficou, porém, definida a tendência.

Entre as atividades mais expressivas (N ≥ 5), a bovinicultura (leite), bovinicultura (carne) e castanha evidenciaram uma clara tendência para o cumprimento dos objetivos produtivos. Em relação à viticultura, kiwi e framboesa, a tendência não ficou definida. O mesmo já não sucedeu em relação aos espargos, cogumelos, helicicultura, apicultura e maracujá, nas quais ficou bem vincado o peso do insucesso. Nas duas últimas atividades, não se registou mesmo qualquer projeto que tenha atingido os objetivos produtivos, sendo de realçar que todos os inquiridos dedicados à cultura do maracujá revelaram que estavam «muito insatisfeitos» quanto aos resultados produtivos. A ocorrência de condições climatéricas adversas foi a principal causa apontada para o desvio entre a produção esperada e a obtida.

O apoio técnico não teve influência no alcance dos objetivos produtivos (P > 0,05), quer para o conjunto das explorações, quer por atividade. O mesmo sucedeu para a classe de investimento e NUTS III.

As candidaturas devidamente submetidas que cumpram os critérios de elegibilidade dos beneficiários e das operações eram hierarquizadas de acordo com a VGO. Pode-se afirmar, com uma probabilidade de erro de 5%, que não existe uma relação causa-efeito entre a VGO e o alcance dos objetivos produtivos e económicos. Ou seja, a VGO não é um indicador de sucesso da operação. Esclarece-se que o fator mais influente na fórmula da VGO era a Taxa Interna de Rentabilidade (TIR), 50% no Anúncio de Abertura nº 3 e nº 4 e 40% no nº 6, embora o seu contributo para efeitos de pontuação não tenha sido proporcional. Desde que a candidatura apresentasse uma TIR igual ou superior a 1%, 1,25% ou 2,5%, respetivamente, em cada um dos citados Anúncios de Abertura, o critério era validado, atribuindo-se a pontuação prevista (20 pontos).

f. Propostas de melhoria expressas pelos inquiridos

Os objetivos da ação 3.1 «jovens agricultores» envolvem o fomento da renovação e rejuvenescimento dos produtores agrícolas e o aumento da atratividade do sector agrícola aos jovens investidores. Por isso, ao tentar-se esboçar propostas de melhoria, nada mais adequado do que dar voz aos próprios jovens agricultores.

O acompanhamento técnico no terreno foi a sugestão mais frequente e partiu também de inquiridos que dele beneficiaram no arranque do funcionamento das respetivas explorações. Esta proposta envolve também o apoio nas questões administrativas próprias da execução dos investimentos, nomeadamente das plantações. Foi significativo o número de jovens agricultores que

tiveram penalizações em consequência de inconsistências nas Verificações Físicas Locais (VFL)[2] (plantações), por uma deficiente elaboração do projeto, execução deficiente ou desconhecimento. Alguns bradaram pelo envolvimento do Estado, na ajuda em questões técnicas e administrativas. Outros clamam que «os organismos do Estado deveriam apoiar e não levantar problemas» e «menos burocracia e mais apoio técnico».

É de realçar que a operação 3.1.1 concede a possibilidade de o jovem agricultor optar pelo recurso aos serviços de aconselhamento, em alternativa à formação agrícola complementar. Contudo, esta opção só foi verificada em 4% dos inquiridos. Por outro lado, o «acompanhamento da candidatura» consta normalmente na lista de investimentos submetidos a financiamento. Porém, salvo raras exceções, diz respeito unicamente à elaboração dos PP. Sabendo-se que esta tarefa também é de extrema importância e que a sua execução não está ao alcance da globalidade dos jovens agricultores, haveria que distribuir a verba disponível pelos dois serviços.

A certificação das empresas de consultoria e dos técnicos projetistas foi também muito referida. Alguns acrescentaram as empresas que prestam outros serviços, por exemplo na instalação de plantações. Os casos litigiosos, alguns dos quais com desfecho nos tribunais, foram abundantes.

Foram apresentados alguns conselhos referentes ao período anterior à aprovação dos projetos de investimento. Os jovens agricultores deveriam visitar diversas explorações ou realizar um estágio/formação numa exploração, antes de apresentarem o projeto. Curiosamente, um inquirido sugeriu a realização de uma prova/entrevista de acesso a jovens agricultores. Segundo ele, é indispensável realizar uma seleção. Mas também houve quem sugerisse mais fiscalização.

Foi significativo o número de jovens agricultores que recomendaram que a formação obrigatória deveria preceder a aprovação da candidatura. Antes da emissão do parecer favorável, deveria haver uma reunião da entidade responsável pela análise da candidatura com o candidato a jovem agricultor. Alguns inquiridos declararam que não esperavam a aprovação do projeto, face à sua improvável viabilidade técnica. Outros declararam abertamente que lhes foi validada a plantação em parcelas que não tinham aptidão para a cultura em causa, sendo por isso sugerida, a visita da exploração no decurso da análise técnico-económica da candidatura.

Agilidade nos licenciamentos camarários e na atribuição de empréstimos bancários, celeridade e fiabilidade na análise das candidaturas e PP, bem como regras para os PP mais simplificadas foram outras das recomendações apresentadas.

5. CONCLUSÕES

Os apoios à instalação de jovens agricultores são fundamentais para a renovação geracional, a criação de postos de trabalho no meio rural, a inovação, o empreendedorismo e a melhoria da eficiência e produtividade das explorações agrícolas, representando cerca de 35.151 candidaturas aprovadas entre 1986 e 2022.

Os resultados apontam que o principal motivo para a instalação como jovem foi a oportunidade de desenvolver uma atividade rentável, com apoio financeiro, e na expetativa de rentabilizar um património fundiário.

Os principais problemas na execução física dos investimentos foram o cumprimento de requisitos administrativos (burocracia), a falta de liquidez, os problemas com fornecedores de bens e serviços e o atraso no processamento dos pedidos de pagamento.

Em vista de uma maior fluidez na verificação das condicionantes contratuais (e comodidade para os jovens agricultores), propõe-se a criação de canais de comunicação digitais entre organismos da Administração Pública, nomeadamente: Municípios, ICNF, IAPMEI, Agência Portuguesa do Ambiente (APA), Comissão de Coordenação da Região Norte (CCDR-N).

Um aspeto muito importante relativo ao grau de satisfação com a produção e rentabilidade das atividades foi que a maioria dos inquiridos (60%) mostrou-se «insatisfeita» ou «muito insatisfeita» com a produção obtida (da principal atividade), aumentando aquele valor para 78%, no que respeita à rentabilidade. Por outro lado, 20% dos inquiridos declararam que não se teriam instalado como jovem agricultor (sobretudo nas atividades amora, cravo, maracujá e morango), enquanto mais de 15% não teriam escolhido a mesma atividade principal (nas atividades de amora, kiwi amarelo e kiwi arguta).

[2] Visitas realizadas pelas entidades protocoladas com o IFAP para realizarem controlos dos investimentos apresentados a pagamento. Todas as VFL realizadas às ações de jovens agricultores na região Norte foram realizadas pela DRAPN, entretanto integrada na CCDR Norte

O cumprimento dos objetivos da ação 3.1 carece de resultados económicos favoráveis, consonantes com as expetativas dos jovens agricultores, o que não se comprovou neste estudo.

Algumas atividades inovadoras, como a produção de espargos, cogumelos, helicicultura e maracujá demonstraram resultados dececionantes, expondo a necessidade de referências técnicas consistentes, formação profissional sólida e apoio técnico no terreno.

O acompanhamento de algumas explorações, com vista à recolha de informação sobre as tecnologias de produção adotadas e os resultados técnicos e económicos obtidos, assim como a experimentação, são aspetos essenciais no apoio à apresentação e análise de projetos de investimento.

Este estudo poderá trazer alguns aspetos relevantes para as futuras operações de jovens agricultores alcançarem melhores resultados. Deverá, também, questionar os organismos da administração pública diretamente implicados nesta matéria. Uma das questões mais importantes a ser levantada é a necessidade de uma avaliação mais rigorosa dos candidatos, atividades e das condições de instalação dos jovens agricultores, concomitantemente com a simplificação da execução e um maior acompanhamento no terreno. Destaca-se, neste contexto, o *overbooking* da despesa pública programada para a operação «3.1.2 – investimento de jovens agricultores na exploração agrícola» (125%), o que demonstra a aprovação de candidaturas e despesa, mas revela uma reduzida taxa de execução, sendo esta a sexta operação com a taxa de execução da despesa contratada mais baixa.

BIBLIOGRAFIA

Comissão Europeia (2015). Needs of young farmers: Report I of the Pilot project: Exchange programmes for young farmers. Directorate-General for Agriculture and Rural Development. ISBN 978-92-79-50608-6.

Cunha, A (2021). Jovens Agricultores: precisamos de uma política robusta e consistente. . Jovens Agricultores: políticas, perfis e desafios. ISA Press. ISBN: 978-972-8669-88-1.

Gonçalves, J. (2019). Investimento de Jovens Agricultores em Agricultura Biológica: expectativas e constrangimentos. Dissertação de Mestrado em Agricultura Biológica, Escola Superior Agrária de Coimbra, Instituto Politécnico de Coimbra.

Guerra, A. e Lopes, J. (2022). Young Farmers as Innovation Enablers in Rural Areas: The Role of The EU's Support in a Portuguese Peripheric Region, Trás-os-Montes. *Revista Portuguesa de Estudos Regionais*, nº 61 2022, 85-103.

INE, 2024. Estatísticas agrícolas de base. Dados estatísticos, bases de dados. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_base_dados. Consultado a 06/06/2024.

Ilhéu, M. (2014). Medidas de Apoio à Instalação de Jovens Agricultores no Continente. *Revista da Rede Rural Nacional* N.º 4, 6-10.

Mateus, T. (2022). Caraterização Socioeconómica dos Jovens Agricultores em Portugal Continental. Dissertação para obtenção do Grau de Mestre em Engenharia Agronómica. Instituto Superior de Agronomia, Universidade Técnica de Lisboa.

Moura, J. (2023). Política Agrícola Comum – Avaliação de Impacto do Apoio à Instalação de Jovens Agricultores em Portugal. Dissertação de Mestrado em Economia e Políticas Públicas, Instituto Superior de Economia e Gestão.

Oliveira, M. e Carvalho, M. (2021). O jovem agricultor em Portugal: avaliação de efeito de políticas. Jovens Agricultores: políticas, perfis e desafios. ISA Press. ISBN: 978-972-8669-88-1.

PDR2020 (2024a). PDR 2020 em números. Atualizado a 30/04/2024 [Consultado. 10/06/2024]. Disponível em em: http://www.pdr-2020.pt/PDR2020-em-numeros

PDR2020 (2024b). Aprovações PDR 2020. Atualizado a 07/06/2024 [Consultado. 10/06/2024]. Disponível em em: https://bo.pdr-2020.pt/pdr2020/aprovacoes

Pinto, A.S. (2014). Quinze conselhos a futuros jovens agricultores. *Revista da Rede Rural Nacional* N.º 4, 34-36.

Portaria nº328-C/2021. Estabelece o regime de aplicação da operação 3.1.1 e 3.1.2 da ação 3.1, «Jovens agricultores», do Programa de Desenvolvimento Rural do Continente PDR 2020.

PRODER (2013). Os jovens agricultores no PRODER: Alguns Indicadores. Disponível em http://www.proder.pt/Handlers/Os%20Jovens%20Agricultores%20no%20PRODER%20-%20Alguns%20Indicadores09f8.pdf

Veras, N. (2022). O investimento na exploração agrícola. *Revista Cultivar*, nº 25, abril 2022. ISSN 2183-5624. Gabinete de Planeamento, Políticas e Administração Geral (GPP), Lisboa.

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Regional Heterogeneity Impact on Capital Structure: The Case of the Textile Industry in Portugal

O Impacto da Heterogeneidade Regional na Estrutura de Capital: O Caso da Indústria Têxtil em Portugal

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Abstract

This study aims to analyze the impact of regional heterogeneity on micro, small and medium enterprises (MSMEs) capital structure. Specifically, this paper studies the regional impact on firms' indebtedness through indicators that measure regional social, economic, and financial development, and also if the determinants that explain firms' debt levels are different across regions belonging to the same country. Fixed effect models are applied to an unbalanced panel data of 1,566 firms of the manufacturing textile industry in Portugal, over the period 2015-2020. The data is collected from the SABI and Pordata databases. Results suggest that regional development, namely regional expansion, and the number of bank branches impact firms' indebtedness. These differences influence the firm's access to different financial funds and can justify the geographical concentration of firms in some regions. We also found a substitute effect of bank and trade credit but only to firms located in the Centre region.

Keywords: Capital structure, debt, regional heterogeneity, regional development, Portugal.

JEL Codes: G32, L67

Resumo

Este estudo tem como objetivo analisar o impacto da heterogeneidade regional na estrutura de capital das micro, pequenas e médias empresas. Especificamente, este trabalho analisa o impacto regional no endividamento das empresas através de indicadores que medem o desenvolvimento social, económico e financeiro regional, e também se os determinantes que explicam o endividamento das empresas são diferentes entre regiões pertencentes ao mesmo país. Para tal são analisados dados em painel não balanceado de 1.566 empresas da indústria transformadora têxtil em Portugal, no período 2015-2020, através de modelos com efeitos fixos. Os dados foram recolhidos nas bases de dados SABI e Pordata. Os resultados sugerem que o desenvolvimento regional, nomeadamente o crescimento regional e o número de agências bancárias têm impacto no endividamento das empresas. Estas diferenças influenciam o acesso da empresa a diferentes formas

de financiamento e podem justificar a concentração geográfica das empresas em algumas regiões. Encontrámos também um efeito substituto do crédito bancário e comercial, mas apenas para empresas localizadas na região Centro.

Palavras-Chave: Estrutura de capital, endividamento, heterogeneidade regional, Portugal.

Códigos JEL: G32, L67

1. INTRODUCTION

Capital structure is not a new theme, but there is still interest in understanding the determinants that explain firms' capital structure decisions (Gajdosikova & Valaskova, 2022). Initially, researchers focused on identifying firm characteristics impact on financial decisions (e.g., Harris & Raviv, 1991; Handoo & Sharma, 2014). Macroeconomic were also introduced to explain firms' indebtedness, as firm decisions depend on the country's economic context (e.g., Terra, 2007; Bernardo et al., 2018). Then, some studies focused on the importance of institutional factors by analyzing cross-country samples (e.g., De Jong et al., 2008; Psillaki & Daskalakis, 2009; Shahzad et al., 2021). More recently, studies focused on cross-regional differences to explain firms' financing patterns, especially for small and medium enterprises (SMEs) (e.g., Butzbach & Sarno, 2019; Ozturk & Yasuda, 2023).

The region where the firm is located may influence funding patterns since not all regions give access to the same economic and social opportunities. Geographical concentration exists, and economic activity is more relevant in specific areas, which creates imperfect competition across firms and disparities regarding regional development (Ascani et al., 2020). Palacín-Sánchez et al. (2013) argued that regional heterogeneity impacts the choice of SMEs' capital structure as it is a combination of several factors. Therefore, this study aims to expand the financial literature on capital structure thematic by understanding the regional influence on the capital structure.

There is an increasing interest in the regional impact on capital structure (see Palacín-Sánchez et al., 2013; Palacín-Sánchez & Di Pietro, 2016; Matias & Serrasqueiro, 2017; Di Pietro et al., 2018; Butzbach & Sarno, 2019; Di Pietro et al., 2019; Ozturk & Yasuda, 2023). This work is distinguished from the existing ones, especially from the work of Matias and Serrasqueiro (2017), who analyze Portuguese SMEs, and Granado et al. (2022) who analyze Portuguese firms from the textile industry. First, we use a more recent period (2015-2021).

Second, we not only focus on total debt and debt maturity (short and long-term debt) but also on specific cases of debt, namely bank credit and trade credit that are less analyzed by researchers but are especially relevant to SMEs. Palacín-Sánchez et al. (2019) argued that bank and trade credits are the two most important forms of financing for small firms. This fact was also confirmed by Berger and Udell (1998) who found that small businesses are financed by owner's equity, loans or credit card debt, and commercial credit. However, trade credit can be dependent on the relationship between the firm and suppliers, which also can justify the spatial concentration of firms in some regions.

Third, more than splitting the sample into regions and comparing the differences in the determinants that explain capital structure as Matias and Serrasqueiro (2017) and others have done, we have introduced quantitative variables that reflect regional economic and social development to understand its impact on capital structure. Ho and Wilhelmsson (2022) show that new firms appear in regions where there is accessibility to bank branches. Therefore, we intend to analyze if the regional development impacts firms' capital structure, which can explain why firms are more located in some regions. Brenner and Niebuhr (2021) argue that there is a need for new policies and strategies to foster the development of some lagging regions. This work gives insights that can give some clues about what is needed to develop some regions.

Finally, control variables to deal with firms' specific characteristics (profitability, size, age, asset structure, growth opportunities, liquidity, and non-debt tax shield), as well as macroeconomic factors (GDP growth and inflation rate), are also added as there is a broad consensus on those factors that show a significant impact on debt (e.g., Bernardo et al., 2018).

To accomplish the work's aim, an unbalanced panel data of 1,566 Portuguese firms from the textile industry is analyzed during the period 2015-2020. To explain capital structure, regional factors that measure its economic and social development, as well as firm's specific determinants and macroeconomic factors are included. The models are estimated for the total sample and per region.

After this introduction topic, where the aim of the study is presented, the literature review appears in section 2. Then, the sample, variables, and methodology are presented. Results are shown and discussed in section 4. Finally, section 5 concludes the study.

2. LITERATURE REVIEW

Capital structure is related to firms' funding options – equity and liabilities, to finance their assets (Shahzad et al., 2021). It impacts the firm's future financial sustainability since an accurate financial mix influences its financial stability and profitability (Gajdosikova & Valaskova, 2022). Some authors have tried to find a theory to explain the optimal capital structure, while others have focused on understanding which determinants are more relevant to explain the firm's capital structure. Even if several works analyze this theme, no conclusive evidence has been reached, as it can depend on the country, industry, and/or regional specificities.

2.1. Capital structure theories

The classic theory, proposed by Durand (1952), argues that there exists an optimal capital structure that allows for maximizing the firm value and minimizing the weighted average cost of capital, through the optimal combination of debt and equity. Later, Modigliani and Miller (1958), under a set of assumptions, report that a firm's capital structure has no impact on its value. However, in 1963 the same authors introduced the assumption of the tax benefits of debt and argued that the firm value increases with debt due to tax savings (Modigliani & Miller, 1963).

DeAngelo and Masulis (1980) developed the trade-off theory that argues that the optimal capital structure results from the balance between the advantages of debt (tax benefits of debt) and its costs and risks (of financial distress).

The agency theory (Jensen & Meckling, 1976) argues that debt is an external mechanism to reduce the conflict of interest between shareholders (the principal) and managers (the agent) by decreasing free cash flows available. Although another type of agency cost appears, between shareholders and creditors/debtholders (Jensen & Meckling, 1976). Higher levels of debt increase creditors' losses in case the firm fails its debt covenants. Thus, equity and debt should be balanced to minimize the total agency costs.

The pecking order theory did not establish an optimal capital structure but adjusted their financial decisions to a hierarchy of funds as a result of cumulative funding needs (Myers, 1984). First, managers prefer to use internal funds - self-funding, to maintain the firm's control. When these sources are scarce, firms resort to external funds, starting with debt and, if the need persists, issuing new equity. This choice is justified by the information asymmetry as managers hold private information about the firm (Myers, 1984; Fama & French, 2002). This is particularly relevant to SMEs as their information is opaquer than to large firms (Palacín-Sánchez et al., 2013) and the degree of uncertainty about public information is greater (Serrasqueiro & Caetano, 2015).

To listed firms, there is also the market timing theory, proposed by Baker and Wurgler (2002) which advocates that firms issue shares (replacing debt) when market value increases. According to this theory, there is no ideal capital structure, but funding decisions result from the fluctuations of the firm's value in the financial market.

2.2. Regional impact on capital structure

Economic and social differences across regions influence the availability of funds to firms, especially to SMEs which have pronounced problems of asymmetric information (Serrasqueiro and Caetano 2015; Di Pietro et al. 2018).

Some studies focus on comparing SME financing decisions between different regions (e.g., Palacín-Sánchez et al., 2013; Matias & Serrasqueiro, 2017; Butzbach & Sarno, 2019; Ozturk & Yasuda, 2023), while others focus on regional development by understanding the impact of some factors as regional GDP, number of bank branches and banking concentration per region (Palacín-Sánchez & Di Pietro, 2016; Di Pietro et al., 2018; Di Pietro et al., 2019). A firm's access to different financial sources may depend not only on the region itself, due to the industry concentration, but also on its economic and social development, as firms have different opportunities whether located in more (or less) developed regions.

Palacín-Sánchez et al. (2013) found differences in debt levels across regions and that firm-factor determinants impact capital structure depending on the region analyzed. The authors justified these differences with regional singularities concerning economic development, financial system structure, tax systems, and/or cultural aspects. A similar analysis was done by Matias and Serrasqueiro (2017) that found that on Portuguese firms debt ratios are affected by the same determinants, but there are differences in debt levels across regions. Butzbach and Sarno (2019) argue that firms in underdeveloped regions (in southern Italy) have more difficulty to access to debt, presenting higher levels of equity than other Italian regions. Ozturk and Yasuda (2023) found some similarities between prefectures regarding some firm-specific determinants that explain firms' capital structure. Moreover, the authors analyze pairs of prefectures and found that there is no clustering and there are similarities across prefecture pairs.

Other studies introduced regional quantitative factors as explanatory factors of firms' capital structure. Palacín-Sánchez and Di Pietro (2016) showed that the regional financial sector and the number of bank branches, impacts SMEs' debt levels. Moreover, the higher concentration of bank branches leads to a decrease in the level of indebtedness. Di Pietro et al. (2018), analyzing Spanish SMEs, found that the regional institutional environment is relevant to explaining debt levels. Less developed regions resort more to debt to invest, due to the lack of internal sources of financing. Di Pietro et al. (2019) also identified regional differences in capital structure of Italian SMEs. A more developed financial sector, as well as regional economic development, has a positive impact on debt levels, as firms have more investment opportunities and the contact with local banks favors the use of debt as a financial source. However, the existence of a concentrated banking market reduces the use of debt since banks ask for less information opacity, which is difficult in SMEs. The authors suggest that regional differences in SME leverage could influence regional economic resilience.

The previous studies mainly focus on Italy, Spain, and Portugal, as these three countries are characterized by substantial differences among regions concerning social and economic development (Butzbach & Sarno, 2019). Only in countries with great differences between geographical areas is relevant to explain its impact on the firm access to external finance.

3. METHODOLOGY

3.1. Sample

This work aims to understand the regional heterogeneity impact on the capital structure of Portuguese MSMEs in the textile manufacturing sector.

In Portugal, MSMEs are 99,9% of Portuguese firms (Pordata, 2023). The capital market is small and relatively underdeveloped compared to other large European countries or the U.S.A. Firms financial sources are mainly owners' equity, trade credit, or bank credit (Palacín-Sánchez et al., 2019). In small firms, the owner is usually the firm manager, and information is not transparent (La Porta et al., 1998). Therefore, these firms are especially financially vulnerable due to financing constraints.

A specific industry - the textile manufacturing industry, is analyzed as firms from the same industry tend to adopt similar financing patterns (La Rocca et al., 2011). Moreover, the firm's variables and agency conflicts are also influenced by the industry in which the firm operates (Di Pietro et al., 2018). Textile manufacturing is one of the oldest and most traditional industries operating in Portugal and is still one of the most relevant (Granado et al., 2022). This industry contributes to Portuguese internationalization, through exports, especially to Spain, France, the U.S.A, Germany, and the U.K., but also imports of materials from Spain, Italy, India, Germany, and

China. Moreover, it contributes to employment, to gross value added (GVA), and to gross domestic product (GDP) (DGAE, 2018).

This industry is present in all of the seven regions of NUTS II (Nomenclature of Territorial Units Statistics) in Portugal: North, Centre, Lisbon, Alentejo, Algarve, Azores and Madeira, which allows the analysis of regional influence. However, most of the textile manufacturing industry is located in the North region (around 68% of the firms in this industry) (INE, 2023) showing the existence of geographical concentration of industries.

There are significant disparities across the Portuguese regions. The next table shows some information per region (average values of 2015-2020).

Table 1: Information per Portuguese region

	North	Centre	Lisbon	Alentejo	Algarve	Azores	Madeira
Firms per Km2	19.9	9.3	118.1	2.7	14.1	11.8	33.5
Firms per 1,000 inhabitants	11.9	11.7	12.5	11.7	15.9	11.3	10.6
GDP growth	2.98	2.92	2.18	1.90	2.85	2.10	1.22
Grant credit/GDP	0.92	0.64	1.82	0.68	0.71	0.90	0.64
Number of bank branches per 1,000 inhabitants	0.05	0.09	0.02	0.13	0.10	0.07	0.09

Source: Data collected from the Pordata database

Most of the Portuguese businesses are in the Lisbon region (which includes the Portuguese capital - Lisbon) and the North region (which includes the second highest city - Oporto). In Lisbon and Oporto, the existence of airports and ports makes it easy to import and export (Banco de Portugal, 2023). This fact is confirmed by the analysis of the previous table as most of the firms per km2 are located in the Lisbon region, followed by Madeira and the North regions. On the opposite, Alentejo is the region with fewer firms per km2. If we analyze the number of firms per inhabitant the majority is in the Algarve region, which is a tourist region, with sun and beach, followed by the Lisbon region.

Analyzing GDP growth, the North and Centre regions are the ones with more economic development (from 2015 to 2020). However, the Lisbon region is still the one that grants more credit over GDP. Finally, analyzing the number of banks per 1,000 inhabitants, the highest value is in the Alentejo region, which can be justified as it is a region with few inhabitants and a high dimension regarding km2. These conclusions suggest that there may exist advantages to industries being concentrated in some regions, for example, the access to specialized workers, and the closest relationship with suppliers and customers. Ascani et al. (2020) argue that there exists a spatial agglomeration of economic activities, contributing to the geographical concentration of firms and persons.

Macroeconomic and regional data was collected in the Pordata database, while firms' financial data was collected from the SABI database (Iberian Balance Sheet Analysis System) from Bureau Van Dijk. Only MSMEs were selected, as large-size firms have different opportunities to access capital markets and the main focus is the maximization of the firms' value, while MSMEs also focus on non-monetary aims to fulfill the personal objectives of their owners/managers (Matias & Serrasqueiro, 2017). Therefore, selected firms are the ones with less than 250 employees, whose turnover does not exceed 50 million euros, or whose total balance sheet does not exceed 43 million euros (Portugal 2020, 2021).

The period analyzed is 2015 to 2020. Portugal suffered a high public deficit after the international financial crisis of 2007/2008 and asked for Troika's financial support to surpass this situation. From 2011 to 2014 several contraction measures were applied (Publico, 2019). We started in 2015 to avoid the impact of the financial crisis. 2020 was the last year with available data at the moment of collection.

The final sample is an unbalanced sample, composed of 1,566 firms in the textile manufacturing industry, with a total of 8,082 observations.

3.2. Measures

To measure capital structure five alternative proxies are used: total debt (TD = total liabilities divided by total assets), debt by maturity – short-term debt (STD = current liabilities divided by total assets), and long-term debt (LTD = non-current liabilities divided by total assets), and specific cases of debt – bank credit (BC = loans and similars divided by total assets) and trade credit (TC = creditors divided by total assets). All variables are based on book values, as the firms analyzed are non-listed.

Most works focus on total debt and debt by maturity (e.g., Handoo & Sharma, 2014; Matias & Serrasqueiro, 2017; Ali et al., 2022; Granado et al., 2022). Portuguese firms from the textile manufacturing industry are highly dependent on short-term debt (e.g., Granado et al., 2022), so analyzing debt by maturity is crucial. Moreover, we also use specific cases of finance, as bank and trade credits are especially relevant to small-size firms, which is the type of firms under study (Berger & Udell, 1998; Palacín-Sánchez et al., 2019). Analyzing different alternatives of financial sources helps us to understand the preferences of debt and to draw an overall picture of MSME's capital structure decisions.

The regional effect is measured in two ways: by analyzing the economic, financial, and social development of the region, and through the analysis per region of the determinants that better explain the capital structure.

- Regional GDP growth is the annual growth of GDP per region (Palacín-Sánchez & Di Pietro, 2016; Di Pietro et al., 2019).
- Number of bank branches is the natural logarithmic of the number of bank branches (Palacín-Sánchez & Di Pietro 2016; Di Pietro et al. 2019).
- Number of bank branches per inhabitant is the number of bank branches divided by 1000 inhabitants (Palacín-Sánchez et al. 2013; Di Pietro et al. 2019).
- Bank deposits over GDP is the total bank deposits divided by the regional GDP (Palacín-Sánchez & Di Pietro 2016; Di Pietro et al. 2018)

As control variables we include: 1) firms' characteristics, namely: profitability (Earnings Before interests and taxes divided by total assets), firm' size (natural logarithm of total assets), firm age, asset structure (fixed assets divided by total assets), growth (annual growth of total assets), liquidity (current assets divided by current liabilities), non-debt tax shields (depreciations divided by total assets); 2) macroeconomic factors: GDP annual growth and inflation rate. These determinants were frequently used by previous researchers and are relevant to explain SMEs capital structure (e.g., Psillaki & Daskalakis 2009; Palacín-Sánchez et al. 2013; Matias & Serrasqueiro 2017; Shahzad et al. 2021; Ozturk & Yasuda 2023).

3.3. Data analysis

Figure 1 shows the conceptual model that this study aims to analyze.

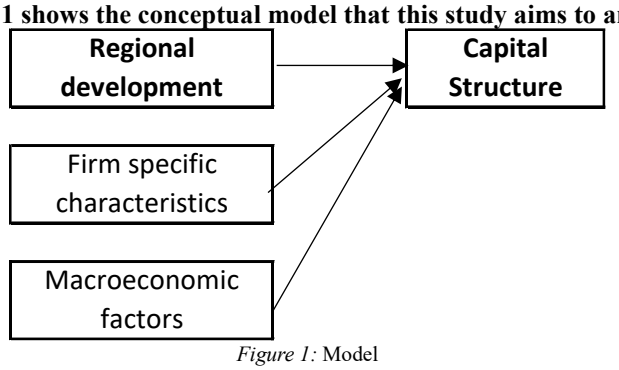


Figure 1: Model

The panel data methodology is used since it reduces collinearity problems and incorporates more degrees of freedom and heterogeneity control (Palacín-Sánchez & Di Pietro, 2016). Several authors such as Palacín-Sánchez et al. (2013), Matias and Serrasqueiro (2017), and Shahzad et al. (2021) used the same methodology for similar studies.

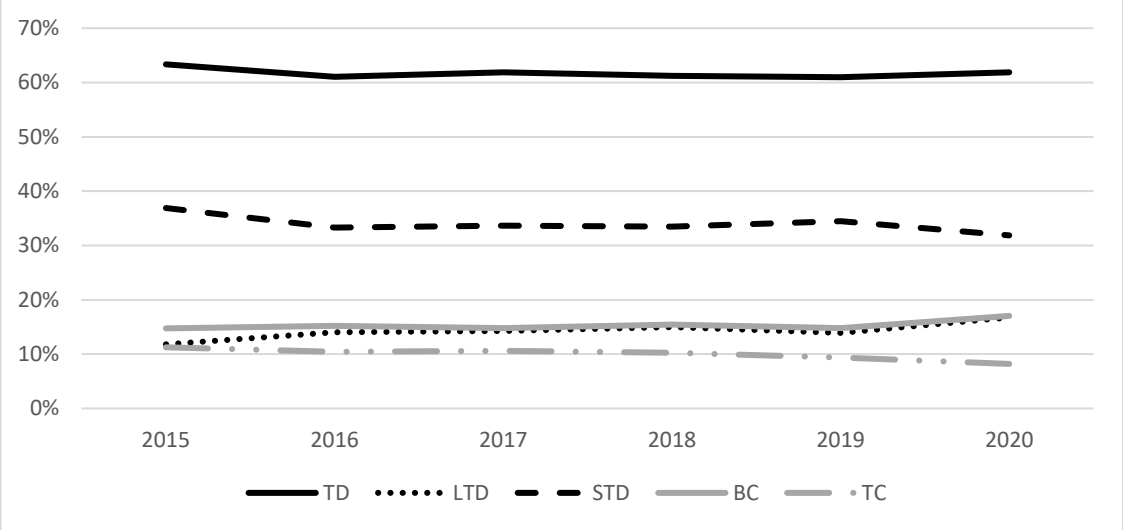
The F Test, the Breusch-Pagan Test, and the Hausman Test are estimated to understand which is the most accurate estimation method: OLS, fixed or random effects.

4. RESULTS

4.1. Sample characterization

The Kolmogorov-Smirnov test showed that the variables are not normally distributed, so the results are compared through median values. The next figure shows the evolution of the median value of the five proxies of capital structure.

Figure 2: Evolution of the median value of capital structure proxies



Note: BC: bank credit; LTD: long-term debt; STD: short-term debt; TC: trade credit; TD: total debt.

Figure 2 shows that Portuguese MSMEs from the textile industry prefer short-term debt over long-term debt. Similar results were found by Granado et al. (2022). Debt levels remain more a less constant over the period analyzed (2016-2020). In 2019 short-term debt slightly decreased and long-term debt suffered the opposite effect, mainly due to the pandemic caused by COVID-19, which caused financial instability. Bank credit is similar to long-term debt, suggesting that when resorting to long-term debt, firms prefer bank loans. Finally, trade credit is residual, suggesting that firms prefer another source of finance than suppliers' credit.

Figure 3: Median value of total debt by region

Figure 3 shows the information on the median values of the capital structure proxies per Portuguese region.

Comparing total debt by region (figure 3), Madeira is the region with the highest indebtedness, followed by Lisbon and Alentejo regions. Azores is the region with lower debt levels but is also the one with less representation in the sample.

4.2. Descriptive statistics

The next table presents the descriptive statistics, namely: mean, median, standard deviation (std. Dev.), minimum, and maximum, for the variables of this study.

Table 2: Descriptive Statistics

	Mean	Median	Std. Dev.	Minimum	Maximum
TD	0.6304	0.6160	0.3411	0.0057	1.9943
LTD	0.2225	0.1435	0.2612	0.0000	1.9571
STD	0.4078	0.3378	0.2980	0.0000	1.9928
BC	0.2140	0.1533	0.2335	0.0000	1.7718
TC	0.1625	0.0997	0.1866	0.0000	1.9329
Regional GDP growth	2.8116	4.3000	3.8363	-15.0000	8.4000
Ln (N. BB)	7.2251	7.2654	0.2890	4.5539	7.4431
N.BB per inhab.	0.0489	0.0461	0.0204	0.0039	0.5164
B Dep/GDP	1.0026	0.9604	0.1166	0.6412	1.7481
Profitability	0.0364	0.0345	0.1645	-2.5044	1.3884
Size	12.9651	12.8026	1.7725	6.7520	19.5288
Age	20.2022	17.0000	16.7621	1.0000	115.0000
Asset Structure	0.2644	0.2158	0.2269	0.0000	0.9916
Growth Opp.	0.2053	0.0350	1.8898	-0.8573	93.4287
Liquidity	3.8742	1.9255	8.6319	0.0000	191.2321
NDTS	0.0425	0.0326	0.0412	0.0000	0.5568
GDP growth	0.6164	2.6800	4.2617	-8.4400	3.5100
Inflation	0.6264	0.5000	0.4627	0.0000	1.4000

Note: B Dep/GDP: bank deposits divided by GDP; BC: bank credit; Growth Opp: Growth opportunities; LTD: long-term debt; N. BB: Number of bank branches; N.BB per inhab: Number of bank branches per 1,000 inhabitants; NDTS: Non debt tax shields; STD: short-term debt; TC: trade credit; TD: total debt.

In the median, 62% of firms' total assets are financed through liabilities. While some firms in the textile industry do not depend on debt, others present negative equity, as the maximum of total debt (TD) is higher than 100%. According to Banco de Portugal, in 2020, on average, small and medium-sized companies in the textile manufacturing sector had around 56% of total debt (Banco de Portugal, 2023), which is slightly lower than that presented (it only refers to one year while we are analyzing a 6-year horizon).

Short-term debt is predominant, with a median of 34% over total assets, while long-term debt weighs 14%. This conclusion corroborates previous findings that firms from the textile industry prefer short-term debt over long-term debt (Granado et al., 2022), and have more difficulties in accessing long-term debt (Serrasqueiro et al., 2016). Bank loans finance (in median) 15% of firms' total assets. Trade credit represents around 10% of total assets which is slightly smaller than the results presented by the Bank of Portugal in 2020 - small and medium-sized companies in the textile manufacturing sector had 15% of trade credit (Banco de Portugal, 2023). Berger and Udell (1998) argue that small businesses are financed by owner's equity, loans, or credit card debt, which is in line with our results.

During the period analyzed, regional GDP growth was positive, but the period analyzed included downturns and upturns. There is also some volatility among the sample (as we saw in Table 1), showing regional disparities.

Bank concentration, measured by ln (number of bank branches) is 7.27, which is similar to those obtained in Italy - 6.40 (Di Pietro et al., 2019), but smaller than the one obtained in Spain - 10.05

(Palacín-Sánchez & Di Pietro, 2016). When dividing the number of bank branches per 1,000 inhabitants the median value is small (0.05), suggesting that there are few bank branches per inhabitants, especially compared to Spain where the mean value was 0.336 (Palacín-Sánchez et al., 2013). The bank deposits over GDP are around 0.96 (median value), which is similar to the value of Italy – 0.94 (Di Pietro et al., 2018), and higher than the value of Spain - 0.84 (Palacín-Sánchez & Di Pietro, 2016).

Moreover, firms from the textile industry are on average profitable, but there is a high dispersion of the data, meaning that not all follow this tendency. Analyzing the variable size shows that there are micro firms but also some medium-sized ones. Firms are around 20 years old (the oldest is 115 years old). The asset structure indicates (median) that 22% of the assets of textile manufacturing firms are fixed assets. Most of the firms present growth opportunities, but there are discrepancies among the sample. Liquidity is in mean and median positive, and higher than 1, suggesting that current assets are sufficient to cover short-term obligations (current liabilities). Finally, depreciations represent around 3% of total assets (median).

In what concerns macroeconomic variables, country GDP growth is smaller (median value) than regional GDP growth, which confirms regional differences. The inflation rate was similar during the period analyzed.

We performed the correlation matrix as well as the VIF (Variance inflation factor) analysis to identify multicollinearity problems[1]. There is a high correlation between regional GDP growth and GDP growth, so we decided not to include the macroeconomic variable GDP growth. The other variables are not highly correlated and neither present a VIF higher than 4.

4.3. Model results

Table 3 reports the estimation results for the total sample, to each capital structure proxy. All models were estimated using fixed effects, as it was the more accurate estimation method.

Table 3: Results for the total sample

	TD	LTD	STD	BC	TC
c	0.4203	−0.5191	0.9394 ***	−0.9703 ***	−0.2615
Reg. GDP growth	−0.0023	−0.0036 ***	0.0013	−0.0035 ***	0.0007
Ln (N. BB)	0.1066 ***	0.0508 *	0.0558 *	0.0787 ***	0.0661 ***
N.BB per inhab.	−0.4110 *	−0.4142 *	0.0032	−0.3939 *	0.0185
B Dep/GDP	−0.0681	−0.0088	−0.0593	−0.0527	−0.0144
Profitability	−0.3647 ***	−0.1431 ***	−0.2215 ***	−0.1476 ***	−0.0991 ***
Size	−0.0315 **	0.0258 **	−0.0573 ***	0.0454 ***	0.0050
Age	−0.0164	−0.0011	−0.0153	0.0200	−0.0231 **
Asset Structure	0.1000 ***	0.2713 ***	−0.1713 ***	0.2353 ***	−0.1106 ***
Growth Opp.	0.0043 **	0.0023 *	0.0020	0.0005	0.0024 *
Liquidity	−0.0042 ***	0.0034 ***	−0.0076 ***	0.0006	−0.0024 ***
NDTS	−0.2760 **	−0.1040	−0.1720	−0.0884	−0.1974 **
Inflation	−0.0005	0.0106 ***	−0.0110 ***	0.0023	0.0055 **
F-test	21.6335 ***	17.2310 ***	18.0635 ***	16.1205 ***	14.0816 ***
Breusch-Pagan test	9637.38 ***	7227.27 ***	6345.67 ***	7955.09 ***	7699.75 ***
Hausman test	67.4361 ***	42.4280 ***	57.9302 ***	38.3398 **	43.4678 ***

Note: B Dep/GDP: bank deposits divided by GDP; BC: bank credit; Growth Opp: Growth opportunities; LTD: long-term debt; N. BB: Number of bank branches; N.BB per inhab: Number of bank branches per 1,000 inhabitants; NDTS: Non debt tax shields; Reg. GDP Growth: Regional GDP growth; STD: short-term debt; TC: trade credit; TD: total debt.

*, **, *** represent a level of 10%, 5% and 1%, respectively.

Results of Table 3 show that not all variables are relevant to explain all capital structure proxies, but when relevant they usually have the same impact, with some exceptions (the control variables: size, asset structure, liquidity, and inflation).

Regional GDP growth negatively explains long-term debt and bank credit. In periods of regional growth, firms increase earnings and can use self-funding to finance their financial needs. Therefore, bank credit and long-term debt (which is mainly composed of bank credit) decrease. This conclusion is in line with the pecking order theory but is the opposite found in Spanish firms (Palacín-Sánchez & Di Pietro, 2016) and Italy (Di Pietro et al., 2019), suggesting specific particularities of Portuguese firms.

[1] Results under request

Regarding the number of bank branches, it positively explains all proxies of debt. Results indicate that the higher the number of bank branches the more the firm's indebtedness. Similar results were found by Palacín-Sánchez and Di Pietro (2016) and Di Pietro et al. (2019), who suggest that more bank branches contribute to decreasing information asymmetries and agency problems.

When the number of bank branches is divided by 1,000 inhabitants, the impact is negative to explain total debt, long-term debt, and bank credit. Table 1 shows that the number of bank branches per 1,000 inhabitants is smaller in regions with more firms per Km2, suggesting that in regions with more persons, there are fewer bank branches, making it more difficult to access bank credit and long-term debt.

The last variable that measures regional economic and social development – bank deposits over GDP, does not impact any capital structure proxy.

Analyzing the control variables, profitability negatively impacts all proxies of capital structure. Profitable firms have more self-funding, so according to the pecking order theory, will use less debt to fulfill financial needs. Similar conclusions were found by Matias and Serrasqueiro (2017) and Shahzad et al. (2021).

Size positively impacts long-term debt and bank credit but negatively impacts total debt, short-term debt, and trade credit. Previous studies also found that the size effect is related to debt maturity. Large-size firms have less information asymmetries and uncertainties so have more ability to access long-term debt and bank loans and prefer to resort to it instead of short-term debt to benefit from tax savings (Rajan & Zingales, 1995; Matias & Serrasqueiro, 2017). This result is in line with the trade-off and the agency theories.

Older firms use less trade credit. These firms usually have more self-funding, according to the pecking order theory, so have fewer financial needs and can pay early to suppliers. Even if some researchers found that age impact depends on debt maturity (e.g., Matias & Serrasqueiro, 2017), our results do not corroborate that finding.

Asset structure positively impacts total debt, long-term debt, and bank credit, while negatively impacts short-term debt and trade credit. Fixed assets can be used as collateral in cases of non-repayment of a debt. Therefore, firms can easily access bank credit, which is most of the long-term debt. This positive impact is suggested by the trade-off, the pecking order, and the agency theories. To short-term credits, the result is the opposite as suppliers and similar prefer firms with higher liquidity as can easily repay the firm's short-term covenants. Similar conclusions were found by Palacín-Sánchez et al. (2013), Serrasqueiro et al. (2016), and Ali et al. (2022).

Growth opportunities positively impact total debt, long-term debt, and trade credit, in line with the proposal of the trade-off, the pecking order, and the agency theories. To expand, firms need more funding, and so increase debt. Moreover, debt is a way to control managers' opportunism to invest in projects that only maximize self-interests, and firms can use debt to benefit from tax savings (Handoo & Sharma, 2014).

More liquid firms have more cash flows and, based on the pecking order theory, can use internal funds to cover financial needs. This impact is found in total debt, short-term debt, and trade credit. However, liquid firms have a lower risk of bankruptcy and can easily access long-term debt, benefiting from tax savings as suggested by the trade-off theory. Similar results were found by Serrasqueiro et al. (2016) and Ali et al. (2022).

The higher the weight of depreciation on total assets the less the total debt and trade credit. Depreciations are tax-deductible, acting as a substitute for debt, as suggested by the trade-off theory. To the other capital structure proxies, the impact of NDTS is not statistically significant.

Finally, the inflation rate positively impacts long-term debt and trade credit but negatively impacts short-term debt. The higher the inflation, the higher the firm's costs, which contributes to increase funding needs. Therefore, long-term debt increases as well as suppliers' credit. Although, as other short-term debtholders may also have financial needs, for short-term debt the effect is the opposite.

As a synthesis, our results show that regional economic, financial, and social development impacts firms' capital structure. Firms have different opportunities in more developed regions, which explains the geographical concentration of industries in those regions. Moreover, firm-specific characteristics as well as macroeconomic factors are also relevant to explain firms' indebtedness, but the relevance of the variables depends on the proxy analyzed. Additionally, there is no unique

theory that explains the total findings, suggesting that firms use a mix of strategies when looking for liabilities to finance their assets.

The next table shows the results of the estimated model per region. The results are presented to the North, Centre, and Lisbon regions, separately, and to other regions, which include Alentejo, Algarve, Madeira, and Azores, since there were few observations in all these regions. The estimation method depends on the proxy and region analyzed and it is identified on the table.

Analyzing Table 4 we see that there are some regional differences. The relevance of the variables that explain each capital structure proxy depends on the region analyzed. Regional GDP growth positively explains short-term debt to the Lisbon region, and trade credit to the Centre region. However, regional GDP negatively explains bank credit to the Centre region. This finding is new since to the total sample, this variable causes a negative impact on long-term debt and bank credit. In periods of regional expansion, firms located in the Lisbon region increase short-term debt as their investments usually increase. In the Centre region, firms look more for trade credit to the detriment of bank credit, suggesting a substitute effect of these specific cases of finance. This fact suggests that not all regions perform in the same way, and there are specific singularities.

The number of bank branches only explains the total debt of other regions and bank credit to firms located in the Centre region, while the number of bank branches per 1,000 inhabitants is special relevant to explaining total debt, long-term debt, and bank credit in other regions, but it also explains trade credit to firms located in Lisbon region.

The variable bank deposits over GDP, which was insignificant to the total sample, positively explains total debt and short-term debt to the Lisbon region, bank credit to firms located in the North region, and trade credit to firms in the Centre region. As there is more money available, firms can easily access debt as suggested by Palacín-Sánchez and Di Pietro (2016) and Di Pietro et al. (2018). Again, to firms located in the Centre region, the impact is the opposite of bank credit, corroborating the substitute effect between bank and trade credit in this region.

Regarding the control variables, when relevant to explain capital structure proxies, are in line with the findings of the total sample. The main difference is the variable age, which presents contradicting signs depending on the region analyzed.

As a synthesis, only the Centre region presents a substitute effect between bank and trade credits. To the other regions, this impact is not relevant, suggesting some particularities of this region.

Table 4: Results per region

	Total Debt				Long-term Debt				Short-term Debt			
	North	**Centre**	**Lisbon**	**Other**	**North**	**Centre**	**Lisbon**	**Other**	**North**	**Centre**	**Lisbon**	**Other**
c	−1.0841	0.5305	1.0730	1.0138	−0.0056	0.0419	0.0825	−0.0536	−1.0785	0.4886	0.1733	1.0674
Reg. GDP growth	0.0053	−0.0057	0.0035	−0.0051	−0.0051	−0.0091	−0.0017	−0.0026	0.0104	0.0034	0.0066 *	−0.0025
Ln (N. BB)	0.5882	0.1850	−0.0114	0.6414 *	−0.2575	0.1449	0.0540	0.0463	0.8457	0.0401	0.0238	0.5951
N.BB per inhab.	−58.5831	−3.7789	−6.2847	−0.4964 **	38.2341	−3.2951	−3.3461	−0.4402 **	−96.8172	−0.4838	−4.8915	−0.0561
B Dep/GDP	0.5175	−0.1806	0.3840 ***	−0.2296	−0.1447	−0.2055	0.0827	−0.0817	0.6621	0.0249	0.3707 *	−0.1479
Profitability	−0.3744 ***	−0.1672 *	−0.4259 ***	−0.7135 ***	−0.1532 ***	−0.0301	−0.2345 **	−0.1032	−0.2212 ***	−0.1370 **	−0.3295 ***	−0.6104 ***
Size	−0.0246 *	−0.0555	−0.0359	−0.3342 ***	0.0320 **	−0.0300	−0.0164	0.0150	−0.0565 ***	−0.0255	−0.0043	−0.3491 ***
Age	−0.0208	0.0088	−0.0943 ***	0.2383 *	−0.0015	0.0004	−0.0721 ***	0.0135	−0.0194	0.0084	−0.0409	0.2248 **
Asset Structure	0.0954 ***	0.0443	0.1192 *	0.5283	0.2694 ***	0.2342 *	0.2044 *	0.5929 ***	−0.1740 ***	−0.1898	−0.1399	−0.0646
Growth Opp.	0.0037 *	0.0634	−0.0006	0.0612 **	0.0020	0.0642	−0.0028	−0.0194	0.0017	−0.0008	0.0016	0.0806 ***
Liquidity	−0.0047 ***	−0.0028 **	−0.0047 *	0.0004	0.0027 ***	0.0059 ***	0.0032	0.0003	−0.0074 ***	−0.0087 ***	−0.0125 **	0.0001
NDTS	−0.2390	0.5846	−0.4862	−3.3824 ***	−0.0946	0.3451	0.2709	−2.4992 **	−0.1444	0.2395	−0.6487	−0.8832
Inflation	−0.0026	0.0056	−0.0047	−0.0250	0.0135 **	0.0224	0.0388 *	−0.0701	−0.0162 **	−0.0168	−0.0363 *	0.0451
F-test	19.4156 ***	2.0811 **	4.7600 ***	19.5147 ***	16.2457 ***	2.3295 **	1.4132	5.0221 ***	15.7214 ***	2.1935 **	3.3807 ***	39.9988 ***
Breusch-Pagan t.	8062.1800 ***	739.7230 ***	434.3470 ***	67.5453 ***	6429.3700 ***	593.6180 ***	178.6330 ***	47.4390 ***	5236.6600 ***	325.4850 ***	377.8830 ***	57.9112 ***
Hausman test	59.7670 ***	31.4888 **	16.9213	88.1386 ***	40.5757 ***	29.5006 ***	21.1455 **	26.6637 ***	58.0570 ***	50.7100 ***	16.5880	172.3120 ***
Method	FE	FE	RE	FE	FE	FE	OLS	FE	FE	FE	RE	FE

	Bank Credit				Trade Credit			
	North	**Centre**	**Lisbon**	**Other**	**North**	**Centre**	**Lisbon**	**Other**
	−2.7213 **	−2.3701	−9.0166	0.5053	−0.9787	−0.0095	−0.5430	0.0519
Reg. GDP growth	0.0060	−0.0109 ***	−0.0152	−0.0029	0.0036	0.0066 **	0.0019	−0.0019
Ln (N. BB)	0.6409	0.5733 **	2.5451	0.0025	0.3348	−0.0446	0.09939	0.1028
N.BB per inhab.	−68.0148	−13.4403	−528.0250	−0.3662 *	−32.6879	4.5668	−8.9181 **	0.0201
B Dep/GDP	0.6889 *	−0.4134 **	−0.3017	−0.1235	0.2038	0.2770 *	0.0721	−0.0084
Profitability	−0.1558 ***	−0.1077 **	−0.0474	−0.1079	−0.1031 ***	−0.0662 *	−0.1573 ***	−0.0149
Size	0.0483 ***	−0.0075	0.0379	−0.0223	0.0082	−0.0127	0.0249	−0.0425
Age	0.0132	0.0895	0.0360	0.0498	−0.0192 *	−0.0188	−0.0770 ***	0.0056
Asset Structure	0.2318 ***	0.2445 **	0.1450	0.7325 ***	−0.1172 ***	−0.0795	−0.1180 **	−0.0509
Growth Opp.	0.0000	0.0465	−0.0007	−0.0177	0.0023 *	0.0109	0.0018 ***	0.0050
Liquidity	0.0002	0.0015	0.0029	−0.0002	−0.0026 ***	−0.0022 ***	−0.0025 *	−0.0000
NDTS	−0.0977	0.1881	0.3900	−2.4374 **	−0.1922 **	−0.1578	−0.2406	−0.0121
Inflation	−0.0018	0.0125	0.0441	−0.0481	0.0022	−0.0001	0.0048	0.0137
F-test	15.4370 ***	2.9189 ***	1.8371 *	6.8265 ***	12.3486 ***	4.3928 ***	4.2054 ***	90.5222 ***
Breusch-Pagan t.	6824.45 ***	656.745 ***	267.510 ***	35.1999 ***	6543.33 ***	445.234 ***	270.104 ***	101.79 ***
Hausman test	47.3983 ***	23.6087 **	23.9180 **	35.5799 ***	42.9207 ***	43.9539 ***	11.0654	19.6085 *
Method	FE	FE	FE	FE	FE	FE	RE	FE

5. CONCLUSION

This work aims to understand the impact of the regional social, economic, and financial development on the capital structure of Portuguese MSMEs in the textile manufacturing industry. The theme of regional heterogeneities has been gaining more attention in the last years since it helps to explain why some regions are less developed than others, and why there is a high concentration of persons and businesses in some geographical spaces (Brenner & Niebuhr, 2021). In Portugal, regional differences exist, with some regions more developed than others.

To have an overall picture of firms' indebtedness, five alternative proxies of the capital structure were used: total debt, long-term debt, short-term debt, bank credit, and trade credit. Conclusions are singular depending not only on debt maturity ratios, which are analyzed by the majority of studies, but also when the specific cases of debt: bank loans, or commercial credit are studied. MSMEs are highly dependent on short-term debt but also on trade credit, and access to bank loans not always is easy. Therefore, understanding different types of capital structure is relevant. Moreover, this study allows us to understand whether bank and trade credit are substitutes or complementary. In our case, the substitute effect of bank credit and trade credit exists only for firms located in the Centre region.

As explanatory determinants, specific variables to measure regional development were used, namely regional GDP growth, number of bank branches, number of bank branches per 1,000 inhabitants, and bank deposits over GDP. Additionally, the analysis was made per region to understand regional impacts. There is no consensus on how to measure regional impact on firms' indebtedness. Most works focus on analysis per region, but our results show that specific variables of regional development are relevant to explain firms' indebtedness. Although, the impact depends on the proxy analyzed and the region study. Regional expansions negatively impact long-term debt and bank credit. When splitting the sample into regions this impact is only found in the Centre region and to explain bank credit. The opposite effect is found in short-term debt to the Lisbon region and trade credit to the Centre region. The number of bank branches also contributes to increased debt levels, but when analyzing the variable per 1,000 inhabitants the impact is the opposite as in regions with more firms per km2, the number of bank branches per inhabitant is smaller. Bank deposits over GDP variables are also relevant to explain some capital structure proxies but only when each region is analyzed separately. These results are in line with previous research that found regional heterogeneity in the capital structure (e.g., Palacín-Sánchez et al., 2013; Palacín-Sánchez & Di Pietro, 2016; Matias & Serrasqueiro, 2017; Di Pietro et al., 2018; Butzbach & Sarno, 2019; Di Pietro et al., 2019; Ozturk & Yasuda, 2023). These conclusions show that more developed regions benefit firms, as they can have access to more funding alternatives, which can help to boost their activity.

Firm-specific characteristics (profitability, size, age, asset structure, growth opportunities, liquidity, and non-debt tax shields), as well as macroeconomic factors (inflation rate), are also relevant to explain MSMEs' capital structure.

This work makes several contributions to the literature by analyzing the regional impact on firms' capital structure, a thematic that is gaining prominence in the last years. We not only analyze which determinants better explain capital structure per region, as most of the works, but we analyze how regional economic and financial development impact firms' financial structure. This last impact is less explored, and as far as we know it was never explored in the Portuguese context. Additionally, we measure capital structure using five different proxies: total debt and debt by maturity, which are the most used proxies, and bank credit and trade credit, two specific cases of finance that are less explored, but which are relevant specially to small-size firms.

In addition to the adds to the literature review, this work also contributes to practice. It helps company managers understand the need to use different forms of financing and what can justify the use of one type over another. It also helps suppliers and banks to understand the financing needs of firms according to the region where they are located. The closer relationship between firms and debtholders and the development of the region impact firms' capital structure. Finally, this work contributes to the government to apply new policies that contribute to reducing regional disparities. Our results show that regions are unique, which may justify why some industries are concentrated in one region rather than another. In a country with large regional differences, the financial decisions not only involve business criteria but also institutional factors that create opportunities depending on where the firm is located.

The aims of the paper were fulfilled, but like all works, this one is not without limitations. First, only one industry from one country was analyzed which, on the one hand, avoids biased results since different sectors have different debt levels, but on the other, it does not allow the generalization of results. For future investigations, it would be interesting to analyze regional differences in other industries and countries. Additionally, other variables to measure regional development, such as the number of firms per region, distance to airports or ports, and municipal investment, could be added. Finally, the impact of internalization of firms and the impact of COVID-19 can be also relevant analysis to understand the change in debt levels and in the factors that explain it, but also the regional differences that can be enhanced in particular cases.

REFERENCES

Ali, S., Rangone, A., & Farooq, M. (2022). Corporate taxation and firm-specific determinants of capital structure: Evidence from the UK and US multinational firms. *Journal of Risk and Financial Management*, 15(2), 55. https://doi.org/10.3390/jrfm15020055

Ascani, A., Faggian, A., & Montresor, S. (2021). The geography of COVID-19 and the structure of local economies: The case of Italy. *Journal of Regional Science*, 61(2), 407-441. https://doi.org/10.1111/jors.12510

Baker, M., & Wurgler, J. (2002). Market timing and capital structure. *The journal of finance*, 57(1), 1-32. https://doi.org/10.1111/1540-6261.00414

Banco de Portugal (2023). Quadros do setor. https://www.bportugal.pt/QS/qsweb/Dashboards

Berger, A. N., & Udell, G. F. (1998). The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of banking & finance*, 22(6-8), 613-673. https://doi.org/10.1016/S0378-4266(98)00038-7

Bernardo, C. J., Albanez, T., & Securato, J. R. (2018). Macroeconomic and institutional factors, debt composition and capital structure of Latin American companies. BBR. *Brazilian business review*, 15(2), 152-174. https://doi.org/10.15728/bbr.2018.15.2.4

Brenner, T., & Niebuhr, A. (2021). Policy options for lagging regions—effects, new approaches and emerging challenges: introduction to the special issue. *Review of Regional Research*, 41(2), 125-130. https://doi.org/10.1007/s10037-021-00162-x

Butzbach, O., & Sarno, D. (2019). To What Extent Do Regional Effects Influence Firms' Capital Structure? The Case of Southern Italian SMEs'. *International Journal of Financial Studies*, 7(1), 3. https://doi.org/10.3390/ijfs7010003

DeAngelo, H., & Masulis, R. W. (1980). Optimal capital structure under corporate and personal taxation. *Journal of financial economics*, 8(1), 3-29. https://doi.org/10.1016/0304-405X(80)90019-7

De Jong, A., Kabir, R., & Nguyen, T. T. (2008). Capital structure around the world: The roles of firm-and country-specific determinants. *Journal of banking & Finance*, 32(9), 1954-1969. https://doi.org/10.1016/j.jbankfin.2007.12.034

DGAE (2018). *Sinopse 2018 – Indústria textil e vestiário*. Direção Geral das Atividades Económicas.

Di Pietro, F., Bontempi, M. E., Palacín-Sánchez, M. J., & Samaniego-Medina, R. (2019). Capital structure across Italian regions: The role of financial and economic differences. *Sustainability*, 11(16), 4474. https://doi.org/10.3390/su11164474

Di Pietro, F., Palacín-Sánchez, M. J., & Roldán-Salgueiro, J. L. (2018). Regional development and capital structure of SMEs. *Cuadernos de Gestión*, 18(1), 37-60. https://doi.org/10.5295/cdg.150530fd

Durand, D. (1952, January). Costs of debt and equity funds for business: trends and problems of measurement. In *Conference on research in business finance* (pp. 215-262). NBER.

Fama, E. F., & French, K. R. (2002). Testing trade-off and pecking order predictions about dividends and debt. *Review of financial studies*, 1-33.

Gajdosikova, D., & Valaskova, K. (2022). A systematic review of literature and comprehensive bibliometric analysis of capital structure issue. *Management Dynamics in the Knowledge Economy*, 10(3), 210-224. https://doi.org/10.2478/mdke-2022-0014

Granado, P., Pacheco, L., & Vieira, E. (2022). A estrutura de capital das empresas industriais portuguesas: O caso do setor do têxtil e vestuário. *Portuguese Journal of Finance, Management and Accounting*, *8*(15). https://doi.org/10.54663/2183-3826.2022.v8.n15.45-77

Hackbarth, D., Hennessy, C. A., & Leland, H. E. (2007). Can the trade-off theory explain debt structure?. *The Review of Financial Studies*, *20*(5), 1389-1428. https://doi.org/10.1093/revfin/hhl047

Handoo, A., & Sharma, K. (2014). A study on determinants of capital structure in India. *IIMB Management review*, *26*(3), 170-182. https://doi.org/10.1016/j.iimb.2014.07.009

Harris, M., & Raviv, A. (1991). The theory of capital structure. *the Journal of Finance*, *46*(1), 297-355. https://doi.org/10.1111/j.1540-6261.1991.tb03753.x

Ho, C. S. T., & Wilhelmsson, M. (2022). Geographical accessibility to bank branches and its relationship to new firm formation in Sweden via multiscale geographically weighted regression. *Review of Regional Research*, *42*(2), 191-218. https://doi.org/10.1007/s10037-022-00166-1

INE (2023). Statistics of Portugal. Portugal, Instituto Nacional de Estatística. https://www.ine.pt/

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), 305-360.

Porta, R. L., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1998). Law and finance. *Journal of political economy*, *106*(6), 1113-1155. https://doi.org/10.1086/250042

La Rocca, M., La Rocca, T., & Cariola, A. (2011). Capital structure decisions during a firm's life cycle. *Small Business Economics*, *37*, 107-130. https://doi.org/10.1007/s11187-009-9229-z

Matias, F., & Serrasqueiro, Z. (2017). Are there reliable determinant factors of capital structure decisions? Empirical study of SMEs in different regions of Portugal. *Research in International Business and Finance*, *40*, 19-33. https://doi.org/10.1016/j.ribaf.2016.09.014

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of financial economics*, *5*(2), 147-175. https://doi.org/10.1016/0304-405X(77)90015-0

Myers, S. C. (1984). Capital structure puzzle. *Journal of Finance*, 39(3), 575-592.

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American economic review*, *48*(3), 261-297.

Modigliani, F., & Miller, M. H. (1963). Corporate income taxes and the cost of capital: a correction. *The American economic review*, *53*(3), 433-443.

Mordor Intelligence 2023. *Textile Industry Size and Share Analysis - Growth Trends and Forecasts* (2023 – 2028). https://www.mordorintelligence.com/industry-reports/global-textile-industry---growth-trends-and-forecast-2019---2024.

Ozturk, H., & Yasuda, Y. (2024). Disentangling prefectural similarities in the capital structure of Japanese SMEs through pairwise testing. *The European Journal of Finance*, *30*(2), 173-204. https://doi.org/10.1080/1351847X.2023.2201470

Palacín-Sánchez, M. J., Canto-Cuevas, F. J., & Di-Pietro, F. (2019). Trade credit versus bank credit: a simultaneous analysis in European SMEs. *Small Business Economics*, *53*(4), 1079-1096. https://doi.org/10.1007/s11187-018-0101-x

Palacín-Sánchez, M. J., & Di Pietro, F. (2016). The role of the regional financial sector in the capital structure of small and medium-sized enterprises (SMEs). *Regional Studies*, *50*(7), 1232-1247. https://doi.org/10.1080/00343404.2014.1000290

Palacín-Sánchez, M. J., Ramírez-Herrera, L. M., & Di Pietro, F. (2013). Capital structure of SMEs in Spanish regions. *Small Business Economics*, *41*, 503-519. https://doi.org/10.1007/s11187-012-9439-7

Pordata (2023). *Portuguese Statistics*. Lisboa, Portugal: PORDATA, Fundação Francisco Manuel dos Santos.

Portugal 2020. (2021 November 2). *PME Pequenas e Médias Empresas* - PT2020.

Psillaki, M., & Daskalakis, N. (2009). Are the determinants of capital structure country or firm specific?. *Small business economics*, *33*, 319-333. https://doi.org/10.1007/s11187-008-9103-4

Público (2019, May 4). *Portugal disse adeus à troika há cinco anos.* https://www.publico.pt/2019/05/04/economia/noticia/portugal-adeus-troika-ha-cinco-anos-1871450.

Rajan, R. G., & Zingales, L. (1995). What do we know about capital structure? Some evidence from international data. *The journal of Finance*, *50*(5), 1421-1460. https://doi.org/10.1111/j.1540-6261.1995.tb05184.x

Serrasqueiro, Z., & Caetano, A. (2015). Trade-Off Theory versus Pecking Order Theory: capital structure decisions in a peripheral region of Portugal. *Journal of Business Economics and Management*, *16*(2), 445-466. https://doi.org/10.3846/16111699.2012.744344

Serrasqueiro, Z., Matias, F., & Salsa, L. (2016). Determinants of capital structure: New evidence from Portuguese small firms. *Dos Algarves: A Multidisciplinary e-Journal*, *28*. doi: 10.18089/DAMeJ.2016.28.2

Shahzad, A., Azeem, M., Nazir, M. S., Vo, X. V., & Linh, N. T. (2021). The determinants of capital structure: Evidence from SAARC countries. *International Journal of Finance & Economics*, *26*(4), 6471-6487. https://doi.org/10.1002/ijfe.2132

Terra, P. R. S. (2007). Estrutura de capital e fatores macroeconômicos na América Latina. *Revista de Administração*, *42*(2), 192-204. https://doi.org/10.1590/S0080-21072007000200007

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Exploring the Application of a Co-Creation Model in Archaeological Tourism: Two Case Studies Developed Under TURARQ's Project Within the Frame of Link Me Up - 1000 Ideas Project

Explorando a Aplicação de um Modelo de Cocriação no Turismo Arqueológico: Dois Estudos de Caso Desenvolvidos no Âmbito do Projeto TURARQ Sob a Égide do Projeto Link Me Up - 1000 Ideias

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Abstract

This paper discusses two projects that revolve around the conceptualization of tourism development instruments within the framework of interpreting and understanding archaeological sites through a sustainable approach as part of TURARQ's initiative. The primary objective was to explore the application of a co-creation model, specifically the 'Project Based Learning' methodology of the "Link me Up" project in the field of archaeological tourism. The first case, 'Show Me the Past', involved the development of a mobile app that utilized an agile requirement analysis to create a prototype. The second case, 'Showcasing Prehistory', focused on entrepreneurship, inclusion, heritage, and sustainability, using a diagnosis of the social issues affecting the Mação territory. The outcomes of the first case included the creation of a Mobile Augmented Reality (MAR) application, which allows users to visualize virtual objects in the real environment of discovery. In the second case, empathy maps were developed, encompassing archaeotourism, the local community, theme parks, and special needs. The findings indicated that these programmes generated high levels of participant satisfaction and positively impacted competency development. However, further studies are required to ascertain the number of participants who have transitioned into entrepreneurs because of their involvement in these projects.

Keywords: Territorial Valorization; Augmented Reality; Heritage and Tourism; Work-based Programmes; Open Innovation Platform.

JEL Codes: R11, R58; L86, Z83; Z32, L83; J24, J29; O31, O32.

Resumo

Este artigo discute dois projetos que giram em torno da conceptualização de instrumentos de desenvolvimento turístico no âmbito da interpretação e compreensão dos sítios arqueológicos através de uma abordagem sustentável como parte da iniciativa do TURARQ. O objetivo principal foi explorar a aplicação de um modelo de cocriação, especificamente a metodologia 'Project Based Learning' do projeto "Link me Up" na área do turismo arqueológico. O primeiro caso, 'Show Me the Past', envolveu o desenvolvimento de um aplicativo móvel que utilizou uma análise ágil de requisitos para criar um protótipo. O segundo caso, 'Mostrar a Pré-história', centrou-se no empreendedorismo, na inclusão, no património e na sustentabilidade, recorrendo a um diagnóstico das questões sociais que afetam o território de Mação. Os resultados do primeiro caso incluíram a criação de uma aplicação Móvel de Realidade Aumentada (MAR), que permite aos utilizadores visualizar objetos virtuais no ambiente real de descoberta. No segundo caso, foram desenvolvidos mapas de empatia, abrangendo o arqueoturismo, a comunidade local, os parques temáticos e as necessidades especiais. As descobertas indicaram que esses programas geraram altos níveis de satisfação nos participantes e impactaram positivamente o desenvolvimento de competências. No entanto, são necessários mais estudos para determinar o número de participantes que transitaram para empreendedores devido ao seu envolvimento nestes projetos.

Palavras-chave: Valorização Territorial; Realidade Aumentada; Património e Turismo; Programas Baseados no Trabalho; Plataforma de Inovação Aberta.

Códigos JEL: R11, R58; L86, Z83; Z32, L83; J24, J29; O31, O32.

INTRODUCTION

TURARQ's project is founded on several principles, among them the notion that the essential aspect of archaeological tourists' experiences is the cognitive acquisition by visitors of an archaeological site, facilitated through identification with the site's nature and functionality. In contextualizing this, it can

be said that the project serves as a testament to human journeys in the past and as a marker of the territory's distinctiveness. Thus, when its researchers were challenged to help students develop their entrepreneurship skills in the field of archaeological tourism within the context of project 'Link me Up' project, they immediately accepted and embraced the challenge. This enthusiasm was particularly strong because implementing co-creation is also a central objective of the TURARQ's project. On the other hand, the concept of co-creation and empirical studies that demonstrate how organizations and individuals interact and exchange resources and ideas to co-create value in tourism are still emerging, especially regarding the co-creation of value linked to new technologies (Payne *et al.*, 2008; Rihova *et al*., 2015; Mijnheer & Gamble, 2022).

In response to our initial question – how a co-creation model such as the Problem-Based Learning (PBL) methodology, supported by the 'Link me Up' project, can be successfully applied in the field of archaeological tourism – we believe that having students co-create experiences and shared situations with the guidance of experts is the most effective way to build trust and a shared understanding. This approach is strong enough to encourage students to move beyond their familiar interfaces and explore new ideas and solutions as they develop. Additionally, it facilitates the creation of new and distinct tourism development strategies and may even inspire students to consider becoming entrepreneurs.

The 'Link me Up' is a project co-funded by 'COMPETE 2020', 'Portugal 2020' and by the European Social Fund (ESF) and it seeks to promote entrepreneurship through the training of young students and/or entrepreneurs aiming to increase the quality of employment and the creation of innovative companies. In addition, this project was created having in view (Link me Up – 1000 ideas, 2023):

1. The creation of ideas and business plans.
2. The co-creation of innovation based on multidisciplinary teams of young students and/or entrepreneurs of Higher Polytechnic Education in Portugal.

In the present paper, we demonstrate how this approach was implemented in practice with the support of researchers (experts) from the Polytechnic Institute of Tomar (IPT), who are responsible for the development of the project TURARQ.

Different projects emerge to bridge the gap between tourism and archaeological sites. Such as the TURARQ project. TURARQ aims to contribute, protect and enhance archaeological heritage in low density areas, as a vehicle for a harmonious integration between the cultural and natural environments, around the notion of landscape and from a perspective of co-construction and dissemination of scientific knowledge for the sustainability of Middle Tagus territory area in Portugal, articulating different stakeholders and combining experiences related with the archaeological site through digital resources (e.g., augmented reality) using the experimentation and reconstruction of prehistoric ways of life to understand the past.

This article aims to highlight two projects implemented using 'Link me Up' support. The projects relate to the idealization of tourism products that can be framed within the logic of interpretation and understanding of archaeological and interpretative sites within a sustainable logic: i) The 'Show Me the Past' case study and ii) the 'Showcasing Prehistory' study case. The first one devises the planning of a technological method for envisioning archaeological sites, more precisely, the Vale do Junco site. The second structures an economically sustainable business model to recreate prehistoric ways of life in an 'ArchaeoPark' which is being built in the Mação Municipality (Middle Tagus region) as part of a project by the Instituto Terra e Memória that counts with the support of TURARQ's project experts.

Concerning the structure, in addition to this introduction, which describes the general perspective of the article, as well as the objectives, in the background section, one provides a literature review, with broad definitions and discussions concerning the use of co-creation initiatives aiming the territorial valorisation. In the methodology section, one exposes and describes the research procedures of the two case studies, as well as the process of the case studies' project development and future ongoing implementation. In the results and discussion section, the results of the first achievements of both case study projects are presented and discussed regarding the data collected, and researchers' interpretation, based on the literature review. One ends the paper with the conclusions that have emerged regarding the proposed plan to enhance archaeological heritage sites.

1. BACKGROUND: THE TERRITORIAL VALORISATION AND THE TURARQ PROJECT

Archaeology also creates cultural heritage and participates in its management (Oosterbeek, 2017), and archaeology while a tourism resource implies its commodification through a very well-planned process that orientates the tourist gaze towards pre-chosen features (Hubbard & Lilley, 2000; Ross & Saxena, 2019). According to Lopes and Mota (2021), innovation has become central when addressing current territorial dynamics, but also in analysing the performance of organisations. In the same line of thought, the UN's (UN, 2020) 2030 Agenda: Sustainable Development Goals (SDGs), reinforces actions aimed at protecting and safeguarding cultural and natural heritage. In this way, archaeological tourism emerges as an important product of the territory, being able to provoke territorial tourism demand and attractiveness.

Archaeotourism or tourism in archaeological sites it is not a new term or concept, many have written about this subject. For example, Ramsey & Everitt (2008), Pacifico and Vogel (2012), Willems and Dunning (2015), Ross *et al.*, (2017), and Erdogan (2021), all tried to clarify the term of archaeotourism saying that it is a significant component of heritage tourism and can be defined as tourist visits or touristic activities at recognisable areas including excavation sites. Others like Thomas and Langlitz (2019:77) express that" archaeotourism raises interest in archaeological sites and cultural heritage and can be a powerful tool for increasing awareness of and support for the conservation and protection of sites".

In Central Portugal, the Tagus River is one of the most relevant territorial assets of the Middle Tagus region and an aggregating element of the territory's heritage. This is one of the reasons why one intends to promote a valorisation work around this important resource. In the context of the last Community Support Frameworks, initiatives of economic valorisation of the territory were developed around this resource, which should be continued. The strategy presented here foresees a set of works to be accomplished, which includes the elaboration of a territorial contextualization, and a strategic vision for the Tagus River. One that identifies the critical success factors, establishes guidelines, objectives, and anchor projects, presents a global programme of action and defines a model of governance, without obliviating the monitoring and follow-up of the project, among other foreseen works around archaeological heritage assets.

The National Programme for Territorial Cohesion (PNCP, 2017:126) seeks "the promotion of Tourism with a view to the enhancement and sustainability of the natural, cultural and landscape heritage of the inland regions" adding that (PNCP, 2017:3):

> "(…) it is urgent to affirm positively the country's interior, (...) to promote and valorise endogenous resources, identify and stimulate structuring projects, align competencies and investments, invest in intelligent economic development and the reinforcement of network activities, (...) thus creating the environment and the conditions favourable to the settlement of people and ensure a new vitality and a sustainable prosperity in the interior regions".

The Tourism National Strategy (ET2027, 2017), known by the acronym ET27, defines five strategic axes and for each one several lines of action were established, some of them extremely important for inland territories. The ET27 also expresses that the local authorities must consider (when drawing up their Local Strategic Tourism Plans) to adapt what the plan advocates to their own local reality. For the inland territories, when considering the development of archaeological tourism and TURARQ's project objectives, one highlights the following lines of action predicted in the ET27:

- Preserve, add value to and use historic-cultural heritage.
- Value and preserve its authenticity.
- Economically leverage natural and rural heritage and ensure its conservation.
- Promote urban regeneration of the cities, regions, and sustainable tourism development of the territories/destinations.
- Structure and promote offerings that meet tourism demand.

- Ensure the transfer of knowledge from educational institutions and research centres to businesses.
- Disseminate knowledge and statistical information.
- Ongoing training of entrepreneurs and managers to lead the tourism of the future – technological, inclusive, and sustainable.
- Mobilise networking and joint promotion between the various sectors.
- Actively involve society in the process of tourism development in the country as a whole and in the regions.
- Promote "tourism for all," from an inclusive point of view, incorporating the various tourism markets/segments.

Portugal has, a clear and consistent strategy for Tourism development, and it is up to the municipalities to study it and adopt it in their respective local strategies. This strategy is already giving excellent results in the metropolitan and coastal areas and needs to be generalised to the rest of the territory, namely to the country's interior.

With the fabulous tourism resources that inland regions and municipalities have, both natural and built, municipalities and all those who are (or may become) directly and indirectly involved in the tourism sector should have the commitment to look at those resources with more ambitious and competent eyes, to value them internally and externally, and to take from them the benefits that their territories and populations need to improve their well-being.

This sectoral exercise should be carried out within the framework of a more comprehensive and planned approach to both territorial tourism planning and marketing, and not in a haphazard and individualised manner, as Martins (2018) says the issue of policy implementation is crucial for the tourism sector, since many strategic tourism plans and policies or are not or are just partially applied, creating a gap between what was intended and what was really accomplished. It makes no sense, for example, to promote tourism initiatives with quality and glamour in unhealthy, degraded, or unsafe urban spaces. Just as it also makes no sense to waste resources (or not save them) on superfluous or redundant initiatives, which is why the National Programme for Territorial Cohesion (PNCP, 2017:4) proposes a "new, more collaborative and more local-based approach that promotes active participation and a committed involvement of local authorities, inter-municipal communities, associations, companies and people in the construction of a more cohesive, more competitive and more sustainable interior".

Taking all this into consideration, the TURARQ's project starts from the observation and identification of a basic error in the dominant practices in the sector: the use of similar strategies for both archaeological and other sites and monuments. By knowing the core of both archaeology and tourist experiences, the cognitive appropriation by the visitor of an archaeological site is, most of the time, very distinct, because it cannot be based on an identification with the nature and functionality of the place. In this sense the TURARQ's project is much aligned with the idea of Goudswaard *et al.*, (2021) that suggested that archaeological knowledge produced in developer-funded archaeology contexts can be built on a locally inspired character that amplifies the spatial quality of the projected development as well as the sites touristic attractiveness. Several researchers underline for example how scientific knowledge, local memory and values associated to historical remains and emotions that they evoke in individuals, or be, intangible elements of archaeological heritage, are kept alive in the collective memory (Carboni & Luca, 2016; Ross *et al.*, 2017; Oosterbeek, 2017).

The TURARQ project is developed in the Middle Tagus (Portugal), in five municipalities (Mação, Tomar, Abrantes, Constância and Vila Nova da Barquinha) on an axis that follows the A23/A13 road and railway axes and the Beira-Baixa/Ramal de Tomar Line. Its mission is to contribute to the protection, amplification, and promotion of archaeological heritage in areas of low density, enhancing it as a vehicle for integration between the cultural and natural environments, around the notion of landscape and from a perspective of co-construction and dissemination of scientific knowledge for the sustainability of the territory of the Middle Tagus, always bearing in mind that "transitions to more sustainable landscapes require that actors change their thinking about using the landscape and act

collectively to implement a shared view on the future" (Opdam, 2020:2629). The goal is to articulate strategies with national entities that manage the territory, heritage, and tourism (CIMT - Intermunicipal Community of the Middle Tagus area; DGPC - Directorate-General for Cultural Heritage and Tourism Centre), with the business sector (NERSANT - Santarém Region Business Association; and PME - Small and medium-sized enterprises) and with UNESCO (United Nations Educational, Scientific and Cultural Organization). Its course of action consists mainly in:

- Securing funding for the project management and development.
- Analysis of existing inventories and developing new ones.
- Management of archaeological landscapes and tourism resources.
- Specialised training and education (tourism products, models of good practices in the preservation of archaeological landscapes) and,
- Marketing and communicating the territory integrated into a systemic logic of a relationship with the stakeholders with interests in the territory.

Therefore, the project has a team gathered with the support of the UNESCO Chair and the three IPT (Polytechnic Institute of Tomar) research centres that integrate the network supported by the FCT – Foundation for Sciences and Technology – (Geosciences Centre, Techn&Art and Ci2). The mission aims to work as an umbrella to integrate different projects applied to archaeological tourism development, combining experiences related to archaeological landscapes through digital resources (for instance, augmented reality) using the experimentation and reconstruction of prehistoric ways of life to understand the past. That is being and was implemented, without forgetting that the way one interprets heritage when aiming to understand its meaning to different groups is a very important task because heritage occurs in different spheres and it is revested of a special significance to political, cultural, educational, and entrepreneurial ends, among other (Nilson & Thorell, 2018).

2. WORKED-BASED PROGRAMMES AND OPEN INNOVATION PLATFORMS: THE 'LINK ME UP' PROJECT.

The 'Link me Up' project (Link me Up – 1000 ideas, 2023) aims at strengthening the interaction with the business and/or organisational community through the participation of Micro-Enterprises, SMEs, Business Associations, Non-profit Organisations (NGOs) and other entities in the processes of co-creation of innovation and entrepreneurship. One of the main objectives is to enhance the training of young higher education students and/or entrepreneurs in the process of creating ideas and co-creating innovation to improve the quality of employment and to help creating their own business or create new ones, or significantly improve, products, processes, and services.

Thirteen polytechnics operate through the stimulation of idea creation, co-creation of innovation and quality entrepreneurship therefore creating value and increasing competitiveness in the territories. The project stimulates an entrepreneurial ecosystem for the economic and social development of each territory through the creation of self-employment, entrepreneurship, and business creation. The diversified involvement of companies and sectors with potential for interaction and creation of differentiated value is an important aspect of the project, and it involves access to international networks with the possibility of involving international companies and students in the process of co-creation of innovation, enhancing opportunities for international contacts and at the same time promoting labour mobility.

In the case studies developed with the help of TURARQ 'experts', one of the most important aspects was the transfer of innovation co-creation knowledge from territories with greater business dynamism to low-density territories (in the Mação municipality). The two study-cases collaborated with the Earth and Memory Institute (ITM) - Mação Polytechnic Study Centre (CEPMAC), where two projects took place related to the idealization of tourist products that fit the logic of interpretation and understanding of archaeological landscapes aiming for sustainable and local development. The two projects were named "Show me the past" project and "Showcasing Prehistory" project. The first one devised the

planning of a technological method for envisioning archaeological landscapes, more precisely, the Vale do Junco archaeological area. One agrees with Opgenhaffen (2021:353) when expressing that "visualization techniques (…) changed archaeological visual literacy and the ways archaeologists create knowledge", furthermore, it was intended to show students that this meaning-making process follows an extended practice of "enhancement" or "pointing out" visual evidence, a practice that clearly demonstrates that visualizations without a context do not speak for themselves. The second project structured an economically sustainable business model to recreate prehistoric ways of life in the Mação ArchaeoSocial Park. This second project was a dauting task for TURARQ's researchers because one of the greatest challenges that experts around the world face is to design archaeological tourism products that will serve the need of introducing and informing their audience about prehistoric life. Nevertheless, literature emphasizes how crucial are creative, engaging, interactive and participatory ways of transmitting knowledge through history-based recreations (Kalogirou et al., 2016). The underlined idea was to give emphasis to this type of archaeotourism experiential products constructed with the help of TURARQ's specialists, such as archaeologists, by providing the opportunity to students to create new products, interpretations, and narratives by themselves, and with that gaining an insight into prehistoric cultural life and the practices therein. The 'Link me Up' project mentors agreed that the best way to develop the students' ideas was to follow Donna R. Braden's frame on how to recreate historical environments. According to Braden (2019) historical environments (including pre-historical), the ones that evoke the lives and activities of people from the past generally:

- Involve a physical setting or space, not a space completely simulated through media or virtual reality.
- Can be of any size.
- Are situated in the context of human habitation, normally in a determined time and space. Although actual past can never be completely known, and these environments can never truly recreate the past, rigorous historic research will ensure the best accuracy. Natural materials and even animals can be added to recreate historical environments.
- Contain a purposeful assemblage of artefacts (and/or replicas) that represent human activity, meant to reinforce the context and the story, to that effect sounds can also be used.
- Tell a compelling story using one or more interpretative techniques. Ideally this story ignites the imagination through drama, narrative, multisensory components, and a good understanding of the target audience(s).

3. METHODOLOGY

In this paper a case study methodology was employed, integrating principles of project-based learning to enhance the investigative approach. This decision was guided by several factors, which we now outline. Qualitative researchers such as Denzin and Lincoln (2017) have recognized the case study methodology as an independent qualitative approach. Moreover, case study research offers a level of flexibility not typically available in other qualitative methods, making it particularly suited to the dynamic, hands-on nature of project-based learning (Hyett *et al.*, 2014). This methodology is deeply connected to core values and intentions and is characterized as "particularistic, descriptive, and heuristic" (Merriam, 2009, pp. 46).

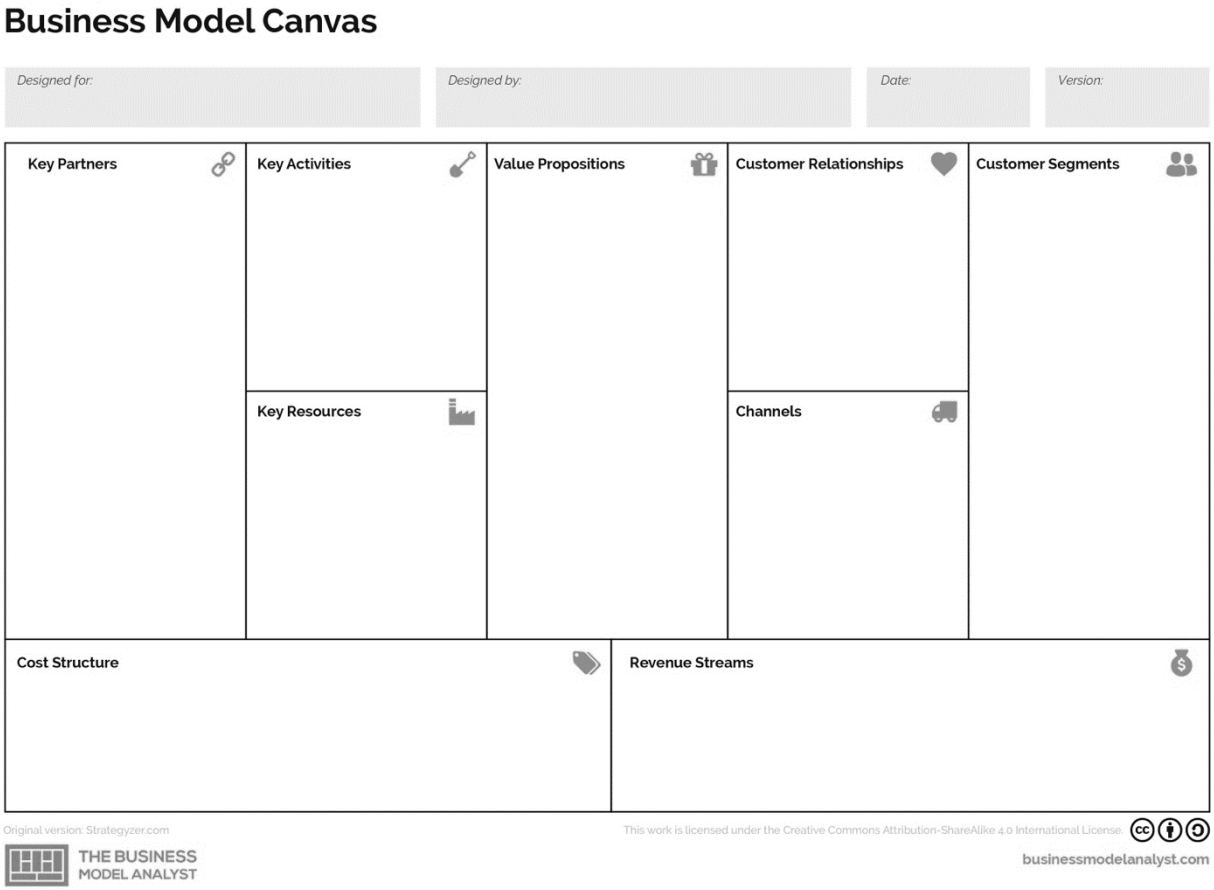
Our case study designs are further informed by Creswell's (2013, pp. 97) definition of a qualitative approach, which "explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information.". This framework is ideally suited to project-based learning, which emphasizes real-world application and the development of solutions over time. The integration of this educational methodology allows for a richer exploration of the cases, encouraging active learning and engagement with the material.

3.1. The use of the Business Model Canvas

As a methodological tool the 'Link-Me-Up' project proposes the use of the Business Model Canvas (BMC). This is a strategic management instrument that allows sketching or developing business models (new or pre-existing), constituting in practice a visual map containing nine blocks to be filled in (Robinson and Lock, 2016).

The attractiveness of the BMC resides in the fact that this provides support to entrepreneurs. It is a tool known for pressuring entrepreneurs to consider each of the business elements individually and as a whole; furthermore, they will have to take on oneself an exercise of constant reflection, that will result in a stimulation of business creativity and innovation (Trimi and Berbegal-Mirabent, 2012). On the other hand, it allows the improvement of a business by the creation of a shared language, supported brainstorming, team building, collaboration, and creating a structure upon which new ideas and innovations can be implemented (Stenn, 2017).

Figure 1. The Business Model Canvas.



Source: https://businessmodelanalyst.com/downloads/business-model-canvas-template-pdf/

3.2. The Augmented Reality Application for Archaeological Tourism – Methodological Procedures

The *Show Me the Past* project consists of an app product, following an agile requirement analysis, until the end of the prototype creation: definition of customer segment, problem, solution, revenue stream, unique value proposition, channels, key metrics, cost structure and competitive advantage. Later, a method of sustainable economic exploitation was applied to the development of tourist structures and local products in association with the second project described in this paper.

The project *Show Me the Past* project aims to create a way to visualize the archaeological landscapes by applying Augmented Reality technology. The app was thought to be applied in Vale do Junco roman area. In Vale do Junco there are a few remains of Roman bath structures. According to some authors, technology has had huge effects on the managing and marketing of tourism areas over the last decades (Gibson & O'Rawe, 2018). Due to new developments in technology, the capabilities of smartphones have expanded greatly and have led to the use of AR in the tourism industry (Han *et al.*, 2018, 2019; Kim *et al.*, 2017; Vert & Vasiu, 2014). Another main reason is that mobile AR is suitable for allowing location-aware applications and services (Vert & Vasiu, 2014) due to its conjunction with the real world. Therefore, destination marketing organisations (DMOs) are placing much greater emphasis on increasing the quality of tourists' experiences, considering AR as a tool to satisfy the needs of tourists in tourism destinations.

Digital technologies are gaining worldwide prominence in various fields, such as cultural and archaeological heritage, with emerging technologies like virtual and augmented reality. For example, Georgopoulos (2018) presents technological advances regarding cultural heritage, such as image-based three-dimensional models and laser scanning techniques to gain three-dimensional information from objects. In addition, some examples related to virtual reality applied to monuments and museums are granted. Peinado-Santana *et al.*, (2021) describes 3D model data capture, information processing and optimization, regarding the 3D digitization of heritage works to make them accessible to the public. As an example, the case study of Ariza Bridge in Spain was presented, where an application that features geo-referencing was developed. The same authors sustain that this can be a suitable instrument for the sustainable study, valorisation, and dissemination of cultural heritage assets. Regarding museums, in general, the artefacts are protected from being manipulated by visitors, so that they cannot be damaged. This fact makes it difficult to promote engagement provided by interaction with the exposed materials. Digital technologies can help solve this problem by reproducing these artefacts, making visits to museums more interesting and interactive (Pretto *et al.*, 2020).

Although the advancement and development of AR in the tourism sector is still in the early stages, it is predicted that it will become the definitive technology of the future (Han, Jun & Gibson, 2013). AR refers to the idea of incorporating 2D images or 3D models into a perception of reality (Woods *et al.*, 2004). Smart glasses with transparent displays or handheld mobile devices, such as iPhones or tablets, can be used to install a camera on the user's head. When using AR, the camera is tracked by a computer that also takes images from a screen on a display. This allows the user to see large objects while also seeing through the visor. AR works when the visor is worn over the camera. Through artificial components, the AR application tricks the user into thinking they are looking through the device into the real world. This is achieved by sending visual data from the artificial components back to the display screen (Neuburger, Neck & Egger, 2018).

3.3. A Business Model applied to Archaeological Tourism – Methodological Procedures

The *Showcasing Prehistory* project follows concepts of entrepreneurship, inclusion, heritage, and sustainability methodology, that starts from the diagnosis of the social problems affecting the territory and the population of Mação. Most territories of low density are structured around three vectors: the low density and demographic dispersion and inhabitants ageing and isolation, the low diversity of economic activities and reduced employment opportunities, and finally, the loss of sociocultural cohesion, which in turn decreases the territorial attractiveness for external investments (PNCC, 2017).

Although this project proposes to contribute to lesser social problems in a transversal and intergenerational way, the focus is related to the multiple dilemmas arising from the ageing population, its dispersion and isolation in Mação's territory, framed in three categories: the construction of a park to recreate prehistoric ways of life (ArchaeoPark), the revolution 4.0 in reducing social risks (Community) and the integrated awareness of entrepreneurship.

The construction of the ArchaeoPark intends to materialize an experience of technological path throughout the History of Humanity, based on a programme of social innovation that promotes intergenerational encounters through activities of social origin anchored in the encounter between

primitive, traditional, and digital technologies and by the combination of old and traditional know-how to pass this knowledge on to younger age groups.

The team's work went through the conceptual framework of a dynamic business model that aimed to prove the financial viability of the business, including its purpose, goals, and its present plans to achieve them. To build this business model, several questions had to be answered: who is the customer? what does it values? how do you deliver value at an appropriate cost? By using Business Model Canvas (*see* Business Model Generation by Alex Osterwalder & Yves Pigneur, 2010), the team found a way to clarify the vision, to review what their value proposition is, what their target audience(s) and partners are, their revenue sources, their distribution channels, among other aspects. Thus, it was possible to structure a clearer idea of the infrastructure itself (key activities; key resources, partner networks), of the offer (value proposition), of the customers, that is, to whom to direct the products and services of the ArchaeoPark; the channels to be used for offering products, the connection that can be established with customers (park visitors) and its management process and a structure of costs and revenue streams to make the park a sustainable structure in the medium to long term.

4. OUTCOMES

The participants in this project were divided into two groups of five elements in each one. Both groups had a multidisciplinary background and the organisation sought not to put in the same team individuals with a similar background.

Furthermore, the organisation scheduled several trips to the sites in way to provide the necessary knowledge about those to the participants. On the other hand, before choosing the groups and their constituents, care was taken to ensure that in the end both groups managed to acquire similar skills, although at first glance this seemed unlikely. Thus, the following competences to be attained were defined for each group:

AR Application for Archaeological Tourism Group

- Develop teamwork skills.
- Develop entrepreneurial capacity.
- Be able to address concepts related to archaeological landscapes.
- Know how to classify the Historical, Cultural and Natural heritage
- Know how to design strategies for the exploitation/use of archaeological landscapes in tourism activities, specially making use of new technologies
- Know how to promote heritage resources as possible virtual tourist attractions.
- Training young higher education students and/or entrepreneurs in the process of creating ideas and co-creating innovation.
- Contribute to the transfer of knowledge and innovation to low-density territories.

Showcasing Prehistory Group

- Develop teamwork skills.
- Develop entrepreneurial capacity.
- Be able to address concepts related to archaeological landscapes.
- Know how to classify Historical, Cultural and Natural heritage.
- Understand the importance of preserving/conserving archaeological landscapes.
- Know how to design strategies for the exploitation/use of archaeological landscapes in tourism activities.
- Know how to promote archaeological landscapes as tourist attractions.
- Training young higher education students and/or entrepreneurs in the process of creating ideas and co-creating innovation.
- Contribute to the transfer of knowledge and innovation to low-density territories.

4.1. Case Study - AR Application for Archaeological Tourism

In the context of 'Link me Up' project (Fernandes & Amante, 2022), one of the challenges proposed to the participants in partnership with Earth and Memory Institute (ITM) was the development of an AR Application for Vale do Junco archaeological area (Figure 2). This is an archaeological area situated in Ortiga parish – Mação, that contains roman remains that were described by many specialists in the area, including M.A.H. Pereira (1970, L. Oosterbeek and S. Cura (2005), J. d'Encarnação and F. Coimbra (2022).

Figure 2. Remains of the roman *villa* of Vale do Junco. © Instituto Terra e Memória.

Until today, only a small area has been excavated, revealing the existence of private baths with similar characteristics to those found at other archaeological sites of the same type: *caldarium* (hot water area), *frigidarium* (cold water area) and a possible *laconicum* (sauna). However, its architecture is unknown because excavation campaigns are at the beginning and only some artefacts were found.

After the programmed trips to the archaeological site the team got the notion that these remains were in a place that was difficult to access and, on the other hand, even on accessing the site, the ordinary citizen might mistake the ruins for an ordinary pile of stones. Therefore, the challenge proposed was to understand how to disseminate this rich heritage and how to make it accessible to the public. Bearing that in mind, every week for three months the team met with the experts of the Instituto Terra e Memória, besides the archaeological experts there were also technological experts.

The result was the development of a Mobile Augmented Reality (MAR) application to display the artefacts found in the excavations. This application allows to visualize virtual objects (artefacts) in the real environment where they were found (captured by the mobile device camera). Moreover, the artefacts can be observed without having to be moved from the museum or laboratory and, above all, without being damaged by human handling. Figure 3 shows some artefacts found at different Roman *villae* and the AR application that was developed to disseminate the archaeological heritage of Vale de Junco.

Figure 3. Roman artefacts and Mobile Augmented Reality application. © Instituto Terra e Memória.

In the future, it is planned to reproduce the thermal baths building to provide the experience of viewing its architecture, as well as its interior, which will include the artefacts.

In addition, it is intended that this application will be used by visitors to this region, to make known its past heritage and make it more attractive, aiming to down the road making it profitable and sustainable. In this regard, the application can be used by several stakeholders. In a first stage, the partner ITM will be the first to use it. In a second stage, other organisations can acquire this resource to preserve and disseminate this and other archaeological heritage all the artefacts found.

4.2. Case Study – Showcasing Prehistory

The Showcasing Prehistory team took into consideration the site of the park, in the municipality of Mação, a municipality in the interior of Portugal, with serious problems of low population density and little economic development. The Municipality of Mação has about 6,402 inhabitants (2021) distributed in an unbalanced way over an area of 399.98 km^2 thus having a population density of 16 inhabitants/km^2.

The team started by identifying potential stakeholders at the local, regional, and national levels: communities, local businesses, structures for the interpretation of the past (museums, interpretative centres, cultural centres), higher education structures with specialised teaching in history, archaeology and conservation and restoration, travel and tourism agencies, interpretative guides, school nuclei and cultural organisations in general. Empathy maps (*see* Bratsberg, 2012) were created. Those were related to a theme, in this case, Tourism, Local Community, Theme Parks, and Special Needs. The Empathy Map is a visual tool that analyses and describes specific aspects of the context of the product to be developed. Design Insights related to experimental research, benefits of both projects' innovation as well as stakeholder profiles, and ideal future solutions (Maguire, 2022).

The work also included visits to the field (archaeological landscapes and theme parks) as well as meetings with experts in the field of business models creation. In the case of the *Showcasing Prehistory* project, concepts of business creation models (using Canvas methodology), sustainability, knowledge,

and the use of local products for boosting the local economy were discussed at the meetings with experts. In the end, that allowed the development of a completely new and innovating tourism product – The ArchaeoPark of Mação

4.3.Competences Outcomes

In the closing meeting between experts and participants, the competences previously defined by the ITM experts were discussed with each group separately, and it was clear to all, experts and participants alike, that all competences were achieved to a greater or lesser degree.

Furthermore, the participants agreed amongst themselves that this experience of co-creation of innovation, creativity and entrepreneurship, will help them in their future employment and some even demonstrated the intention of applying the knowledge that they gained in this project in the creation of their own business.

5. DISCUSSION

The major goal of this article was to highlight two projects related to the idealization of archaeotourism with the assist of 'Link me Up' as a support system and to answer the question about how a co-creation model can be applied in the field of archaeological tourism with success. 'Link me Up' support system brought new insights and strategies to co-creation and innovation, regarding creativity and entrepreneurship projects that aims to join archaeological culture heritage and tourism development with the needs of citizens while involving the whole community in this social innovation (Einarson & Lundblad, 2014). In fact, both case studies presented in this paper reflects how young students while entrepreneurs and experts can work to propose new products/services and even businesses that could create employment. It also investigates the role that higher education can play in enhancing tourism in low-density areas, taking advantage of archaeological landscapes, without disregarding the needs of all stakeholders with interests in the territory, including local communities and visitors. In the case of the *Showcasing Prehistory* group, the team had to learn the way of working with BMC (Business Model Canvas). According to Robinson and Lock, early in the decade of the 2010s, Alexander Osterwalder and Yves Pigneur created the Business Model Canvas as a shared language for describing, visualizing, assessing, and changing business models. It describes in a clearly, simply, and unbureaucratically way business models. Additionally, it helps the organisation establish a common understanding of the business model, which in turn encourages discussion about the business model and ongoing improvement.

The Business Model Canvas upholds the corporate value generation idea. The four most crucial sectors of the business are divided into the nine transformational steps from the value development process. More important, it was necessary to research on features like who is the customer? What does he value? How do you deliver value at an appropriate cost? In the case of the work regarding the business model of the experimental ArchaeoPark of Mação, this work was important because besides being an original project in Portugal, it is difficult to calculate the value connected to it.

The important aspect for both study-cases was the opportunity to bring together experts and students in the co-creation of a project that helped both sides to explore the future impacts and driving forces. Both experts and students were able to understand the future requirements for products, services and explored changes in consumer behaviour, and discovered new technology needs. Teams from diverse backgrounds learned how to work together, how to co-create together considering each member skills, learning wants and motivations. In the end, the inter and multi-disciplinary teams also learned how to apply their own knowledge and competences in the service of the team in a way to find solutions to solve the problem(s). Final reports indicate that this programme leads to high levels of participant satisfaction and has a significantly positive impact on the development of competences. Nevertheless, studies must be made to understand if the participants have become entrepreneurs and whether they have used the competences acquired in this project in developing their entrepreneur skills.

6. CONCLUSION AND FUTURE RESEARCH AVENUES

In this regard, 'Link me Up' concept creates a hub for collaboration between businesses and universities (as well as other groups), with facilitators and guidelines, suggesting using an agile development approach to create projects (Ghimire & Charters, 2022), allowing that students and entrepreneurs learn how to work with BMC (Business Model Canvas), which helps the organisation to establish a common understanding of the business model, and encourage discussion about the business model and ongoing improvement (Osterwalder & Pigneur, 2010).

Further research must still be made related with AR application for archaeological tourism, one that aims to reproduce other parts of the archaeological heritage, to allow visitors to have a deep understanding of past ancestors' daily routines (like the thermal baths in a way to provide the experience of viewing its architecture, as well as its interior, which will include the artefacts). The application of virtual and augmented virtual tools in archaeological sites will hold an immense importance in the field. These technologies when developed properly allow for enhanced visualization, interpretation, and preservation of cultural heritage, enabling researchers and visitors to engage with archaeological sites in new and immersive ways. Virtual tools provide realistic reconstructions of ancient structures and artefacts, facilitating virtual tours and educational experiences that transcend physical limitations. This integration of technology within archaeology enhances understanding, documentation, and accessibility of cultural heritage, fostering broader public engagement and contributing to the preservation and interpretation of our shared human history.

This paper describes an innovative project that was made in a co-creation model environment, i.e., presentation of a challenge-issue by an institution to students from different backgrounds having training and co-creation tools, entrepreneurship, business models, development of digital applications to a certain area (archaeology) and a good dose of creativity.

REFERENCES

Bellini, Heather, Chen, Wei, Sugiyama, Masaru, Shin, Marcus, Alam, Shateel, Takayama, Daiki. (2016). Virtual & Augmented Reality: Understanding the Race for the Next Computing Platform (Goldman Sachs). *Profiles in Innovation*, 1-30. Retrieved from: https://www.gspublishing.com/content/research/en/reports/2016/01/13/eb9acad9-3db9-485c-864d-321372a23726.pdf

Braden, Donna R. (2019). *Spaces that Tell Stories: Recreating Historical Environments*. Lanham, Maryland: Rowman & Littlefield Publishers.

Bratsberg, Hanne M. (2012). *Empathy Maps of the FourSight Preferences*. Creative Studies Graduate Student Master's Projects. Paper 17. Retrieved from: https://digitalcommons.buffalostate.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1180&context=creativeprojects

Carboni, Nicola & de Luca, Livio (2016). Towards a conceptual foundation for documenting tangible and intangible elements of a cultural object. *Digital Applications in Archaeology and Cultural Heritage*, 3(4),108-116. https://doi.org/10.1016/j.daach.2016.11.001

Creswell, John W. (2013). *Qualitative inquiry and research design: Choosing among five approaches*, 3rd edition, Thousand Oaks, CA: Sage.

D'Encarnação José & Coimbra Fernando (2022). Estatueta de Bronze de Vale do Junco (Ortiga, Mação). *Antrope*, (14), 177-190. Retrieved from: https://estudogeral.uc.pt/bitstream/10316/100278/1/Estatueta%20de%20bronze%20de%20Vale%20do%20Junco%20%28Ortiga%2C%20Ma%C3%A7%C3%A3o%29.pdf

Denzin Norman, K.; Lincoln Yvonna S. (2017). *The SAGE handbook of qualitative research*, 5th edition. Thousand Oaks, CA: Sage.

Einarson, Daniel & Lundblad, Henrik. (2014). "Demola - The upcoming win-win relationship between university and industry". [Conference Paper]. Proceedings of the 10th International CDIO Conference, Universitat Politècnica de Catalunya, Barcelona, Spain.

Erdoğan, Hasan Ali (2021). *A Key to Various Opportunities for the Development in Culture, Economy and Integration in Asia Minor: A Successful Archaeotourism Planning*. Yaşar Üniversitesi E-Dergisi. Special Issue on Managing Tourism Across Continents, 30-39. https://doi.org/10.19168/jyasar.807404

ET2027 (2017). Estratégia de Turismo. Retrieved from: http://www.turismodeportugal.pt/SiteCollectionDocuments/estrategia/estrategia-turismo-2027.pdf

Fernandes, Rosina & Amante, Susana (2022). *From Teachers Innovative Practices to Students Co-Creation: A Glimpse of the Project Link Me Up–1000 Ideias*. [Conference Paper]. European Conference on Innovation and Entrepreneurship. Proceedings of the 17th European Conference on Innovation and Entrepreneurship, ECIE 2022. Retrieved from: https://papers.academic-conferences.org/index.php/ecie/article/view/396

Georgopoulos, Andreas (2018). Contemporary Digital Technologies at the Service of Cultural Heritage. In Chanda, B., Chaudhuri, S., Chaudhury, S. (eds), *Heritage Preservation* (pp. 1-20). Springer, Singapore. https://doi.org/10.1007/978-981-10-7221-5_1

Gibson, Alex, & O'Rawe, Mary (2018). Virtual Reality as a Travel Promotional Tool: Insights from a Consumer Travel Fair. In T. Jung & M. C. tom Dieck (Eds.), *Augmented Reality and Virtual Reality: Empowering Human, Place and Business* (pp. 93-107). Springer International Publishing. https://doi.org/10.1007/978-3-319-64027-3_7

Ghimire, Dipendra & Charters, Stuart (2022). The Impact of Agile Development Practices on Project Outcomes. *Software*, 1, 265-275. https://doi.org/10.3390/software1030012

Goudswaard, Boudewijn, Bos, Jolanda, van Roode, Sigrid, Pape, Harry (2012). Forward with reverse archaeology. *Heritage & Society*, 5(1), 101-115. https://doi.org/10.1179/hso.2012.5.1.101

Han, Dai-In Danny, Dieck, Tom, M. Claudia, & Jung, Timothy (2019). Augmented Reality Smart Glasses (ARSG) visitor adoption in cultural tourism. *Leisure Studies*, 38(5), 618–633. https://doi.org/10.1080/02614367.2019.1604790

Han, Dai-In Danny, Jung, Timothy & Gibson, Alex (2013). Dublin AR: Implementing augmented reality in tourism. In Z. Xiang, & Tussyadiah, I. P. (Eds.), *Information and communication technologies in tourism 2014* (pp. 511-523). Cham: Springer Nature International.

Han, Dai-In Danny, Dieck, Tom, M. Claudia, & Jung, Timothy (2018). User experience model for augmented reality applications in urban heritage tourism. *Journal Heritage Tourism*,13, 46-61. https://doi.org/10.1080/1743873X.2016.1251931

Hyett, Nerida; Kenny, Amanda & Dickson-Swift, Virginia (2014). Methodology or method? A critical review of qualitative case study reports. International Journal of Qualitative Studies on Health and Well-being, 9(1), 23606. https://doi.org/10.3402/qhw.v9.23606

Hubbard, Phil & Lilley, Keith (2000). Selling the past: Heritage-tourism and place identity in Stratford-upon-Avon. *Geography*, 85(3), 221-232. http://www.jstor.org/stable/40573703

Kim, Hayun, Matuszka, Tamás, Kim, Jea-In, Kim, Jungwha, & Woo, Woontack (2017). Ontology-based mobile augmented reality in cultural heritage sites: Information modeling and user study. *Multimedia Tools and Applications*, 76, 26001-26029. https://doi.org/10.1007/s11042-017-4868-6

Kalogirou, Konstantina, Sarwar, Sian & Trimmis, Konstantinos (2016). 'Let's meet the Red Lady of the Paviland': Delivering the Prehistoric Narratives in Museum Education. *Drama Magazine*, 22(2), 9-15.

Link me Up – 1000 ideas (2023). *Support System for the co-creation of innovation, creativity and entrepreneurship*. Retrieved from: https://www.cocreationportugal.com/

Lopes, Raul & Mota, Bruno (2021). Innovative local policies in Portuguese low-density rural areas. *European Countryside*, 13(2), 388-409. https://repositorio.iscte-iul.pt/bitstream/10071/23300/1/article_83422.pdf

Maguire, Martin (2022). A Framework for User-Requirements Analysis and Development of Creative Design Concepts. In *HCI International 2022 - Late Breaking Papers. Design, User*

Experience and Interaction. HCII 2022. Lecture Notes in Computer Science, 13516. Cham: Springer. https://doi.org/10.1007/978-3-031-17615-9_7

Martins, Marco (2018). Tourism Planning and Tourismphobia: An Analysis of the Strategic Tourism Plan of Barcelona 2010-2015. *Journal of Tourism, Heritage & Services Marketing*, 4(1), 3-7. https://doi.org/10.5281/zenodo.1247519

Merriam, Sharan B. (2009). *Qualitative research: A guide to design and implementation*, 3rd edition. San Francisco, CA: Jossey-Bass.

Mijnheer, Cristina & Gamble, Jordan (2022). Innovating with stakeholders to co-create value in cultural tourism experiences: a case study of Schokland in the Netherlands. *Journal of Marketing Management*. https://doi.org/10.1080/0267257X.2022.2139284

Neuburger, Larissa, Beck, Julian & Egger, Roman (2018). The 'Phygital' tourist experience: The Use of augmented and Virtual reality in Destination Marketing. In M. A. Camilleri (eds), *Tourism Planning and Destination Marketing* (pp.183–202). Emerald Publishing.

Nilson, Tomas & Thorell, Kristina (2018). *Cultural Heritage Preservation: The Past, the Present and the Future*. Halmstad: Halmstad University Press.

Oosterbeek, Luiz (2017). Dilemmas of archeology in-between society and territory, in a century in which almost nothing will remain as before but nobody knows how it will be in the future. In L. Oosterbeek (Eds.), *Cultural Integrated Landscape Management: A Humanities Perspective* (pp.19-31). Arkeos, 43. Mação: Instituto Terra e Memória.

Oosterbeek, Luiz (2019). *Resilience and Transformation in the territories of low demographic*. Studies in Honnour of Prof. José Bayolo Pacheco de Amorim, on occasion of the establishment of the UNESCO-IPT chair on Humanities and Cultural Integrated Landscape Management. Instituto Terra e Memória.

Oosterbeek, Luiz and Cura, Sara (2005). O Património Arqueológico do Concelho de Mação. *Zahara*, 17-32.

Opdam, Paul (2020). Navigating the space between landscape science and collective action for sustainability: identifying key factors in information processing. *Landscape Ecology*, 35, 2629–2639. https://doi.org/10.1007/s10980-020-01028-2

Opgenhaffen, Loes (2021). Visualizing Archaeologists: A Reflexive History of Visualization Practice in Archaeology. *Open Archaeology*, 7(1), 353-377. https://doi.org/10.1515/opar-2020-0138

Osterwalder, Alexander and Pigneur, Yves (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. John Wiley and Sons.

Payne, Adrien, Storbacka, Kaj & Frow, Pennie (2008). Managing the co-creation of value. *Journal of the Academy of Marketing Science*, 36, 83-96. https://doi.org/10.1007/s11747-007-0070-0

Pacifico, David & Vogel, Melissa (2012). Archaeological sites, modern communities, and tourism. *Annals of Tourism Research*, 39(3), 1588-1611. https://doi.org/10.1016/j.annals.2012.04.002

Peinado-Santana, Sara, Hernández-Lamas, Patricia, Bernabéu-Larena, Jorge., Cabau-Anchuelo, Beatriz, & Martín-Caro, José António (2021). Public works heritage 3D model digitisation, optimisation and dissemination with free and open-source software and platforms and low-cost tools. *Sustainability*, 13(23), 13020. https://doi.org/10.3390/su132313020

Pereira, Maria Amélia da Horta Pereira (1970). *Monumentos históricos do concelho de Mação*. Mação: Câmara Municipal de Mação.

PNCP (2017). *Programa Nacional para a Coesão Territorial*. 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

Pretto, Niccoló; Micheloni, Edoardo; Gasparotto, Silvia; Fantozzi, Carlo; Poli, Giovanni & Canazza, Sergio (2020). Technology-enhanced interaction with cultural heritage: an antique pan flute from Egypt. *Journal on Computing and Cultural Heritage*, 13(2), 1-20. https://doi.org/10.1145/3355395

Ramsey, Doug, & Everitt, John (2008). If you dig it, they will come! *Tourism Management*, 29(5), 909–916. https://doi.org/10.1016/j.tourman.2007.11.002

Rihova, Ivana; Buhalis, Dimitrios; Moital, Miguel and Gouthro, Mary-Beth (2015). Conceptualising Customer-to-customer Value Co-creation in Tourism. *International Journal of Tourism Research*, 17, 356-363. https://doi.org/10.1002/jtr.1993

Robinson, Mark and Lock, Sara (2016). Introduction: Introducing the Business Model Canvas. Culturehive, 10p.

Ross, David; Saxena, Gunjan (2019). Participative co-creation of archaeological heritage: Case insights on creative tourism in Alentejo, Portugal. *Annals of Tourism Research*, 79, 102790. https://doi.org/10.1016/j.annals.2019.102790

Ross, David; Saxena, Gunjan; Correia, Fernando & Deutz, Pauline (2017). Archaeological tourism: A creative approach. *Annals of Tourism Research*, 67, 37-47. https://doi.org/10.1016/j.annals.2017.08.001

Stenn, Tamara L. (2017). Focus on the Business Model Canvas. In: T.L Stenn (Eds.), *Social Entrepreneurship as Sustainable Development* (pp. 55-89). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-48060-2_4

Thomas, Ben, & Langlitz, Meredith (2018). Archaeotourism, Archaeological Site Preservation, and Local Communities. In Douglas C. Comer and Annemarie Willems (Eds.), *Feasible Management of Archaeological Heritage Sites Open to Tourism* (pp.69–78). https://doi.org/10.1007/978-3-319-92756-5_7

Trimi, Silvana and Berbegal-Mirabent, Jasmina (2012). Business Model Innovation in Entrepreneurship. *International Entrepreneurship and Management Journal*, 8(4), 449–465. https://doi.org/10.1007/s11365-012-0234-3.

Turismo de Portugal. (2017). *Turismo de Portugal*. http://travelbi.turismodeportugal.pt/pt-pt/Paginas/HomePage.aspx

UN (2020). *Global Indicator Framework for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development*. UNSD. Retrieved from: https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202020%20review_Eng.pdf

Vert, Silviu, Vasiu, Radu (2014). Relevant Aspects for the Integration of Linked Data in Mobile Augmented Reality Applications for Tourism. In: Dregvaite, Giedre, Damasevicius, Robertas (eds), *Information and Software Technologies. ICIST 2014. Communications in Computer and Information Science*, vol. 465. Springer, Cham. https://doi.org/10.1007/978-3-319-11958-8_27

Willems, Annemarie and Dunning, Cynthia (2015). Solving the puzzle: The characteristics of archaeological tourism. In: Monique H. van den Dries, Sjoerd J. van der Linde & Amy Strecker (Eds.), *Fernweh: Crossingborders and connecting people in archaeological heritage management* (pp. 68–71). Leiden: Sidestone Press.

Woods, Erik; Billinghurst, Mark; Looser, Julian; Aldridge, Graham, Brown, Deidre, Garrie, Barbara, & Nelles, Claudia (2004). Augmenting the science centre and museum experience. (Conference Paper]. *Proceedings of the 2nd international conference on computer graphics and interactive techniques*, Australasia and Southeast Asia.

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Dinâmica de Adoção da Economia Circular ao Nível Regional: o Caso da Grã-Canária e da Madeira

Dynamics Of Adoption of Circular Economy at Regional Level: The Cases of Gran Canaria and Madeira

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Resumo

A economia circular (EC) surge como um tópico mediático, mobilizador e apelativo para múltiplos "stakeholders", incluído o setor empresarial, turistas e entidades públicas, dado o consenso existente à volta da problemática da sustentabilidade e das alterações climáticas. Contudo, as decisões empresariais nesta área revestem-se ainda de um carácter voluntário, numa série de áreas e medidas. A relevância estratégica do setor turístico no contexto insular, assente numa dinâmica de colaborações e de subcontratação de serviços, sugere que o mesmo pode desempenhar o papel de modelo e exemplo, e de pressão sobre o tecido empresarial no sentido da adoção generalizada da EC, desde que salvaguardada uma intervenção estratégica por parte dos governos regionais e locais. Este estudo, baseado numa abordagem quantitativa sustentada num questionário, socorre-se de um modelo "fractional logit" para efeitos de análise das variáveis explicativas da taxa de adoção de iniciativas na área da EC. Com base numa amostra de conveniência de 90 estabelecimentos hoteleiros da Grã-Canária e da Madeira, são identificados os fatores explicativos da taxa de adoção de medidas em quatro subáreas distintas (água e energia; reciclagem; sustentabilidade; e pessoal e Responsabilidade Social e Corporativa (RSC)) de forma a identificar áreas de relevo para a intervenção por parte da administração pública. Os resultados destacam o papel do grau de comprometimento por parte dos diretores hoteleiros, e das barreiras percecionadas e do acesso a recursos disponibilizados pelas autarquias, o que releva o papel das câmaras municipais e dos governos regionais. Identicamente importante os fatores

estatisticamente insignificantes, nomeadamente a ausência de pressão por parte de clientes e fornecedores.

Palavras-chave: economia circular; setor do turismo; hotelaria; *fractional logit*; governo regional;

Códigos JEL: Q2; Q3; Z32

Abstract

The concept of circular economy is an increasing mediatic, inspiring and appealing topic to a wide range of stakeholders, including the business sector, tourists and public officials, given the consensus around the themes of sustainability and climate change. Most decisions, interventions and measures adopted in circular economy arena are still based on a voluntaristic approach. The strategic relevance of the tourism sector in the island context based on commercial based collaborations and subcontracts suggest it may play a leading role in pressuring other sector of the economy to adopt circular economy related initiatives, provided that both local and regional governments think and act strategically. This study adopts a quantitative approach based on a questionnaire, and emplyes a fractional logit model to identify the explanatory variables promote g the adoption of EC measures. Based on a sample of 90 hotels from Grã Canaria and Madeira, we identify in this study the factors driving the adoption rate of measures in four areas (water and energy; recycling; sustainability; and Human Resources and Corporate Social Responsibility (CSR)) in order to recommend priority areas for the government. The results highlight the relevance of the factors respondent´s degree of commitment, perceived barriers and access to resources. While the key role to be played by municipalities and by the regional government is discussed, the lack of statistical significance of some variables, namely lack of pressure from suppliers and customers is also examined.

Keywords: circular economy; tourism sector; hotel industry; fractional logit; regional government;

JEL codes: Q2; Q3; Z32

1-INTRODUÇÃO

A temática da economia circular (EC) surge como um tópico crescentemente relevante no contexto da política de desenvolvimento regional a nível europeu (European Commission, 2017; European Commission, 2020; Pascale et al., 2023; Kirchherr et al., 2023; Savini, 2023), dada a relevância dos temas das alterações climáticas, escassez de recursos críticos, e desenvolvimento sustentável, ao nível da definição das prioridades de desenvolvimento regional (Healey, 1997; Olesen, 2013; Bolger e Doyon, 2019; Gura et al., 2023; Meili e Stucki, 2023). A discussão à volta do tópico da EC no contexto europeu procura adicionar um elemento de racionalidade científica-económica à questão da sustentabilidade e da preservação dos ecossistemas, balizado pelas preocupações de inovação, competitividade e criação de emprego (Ghisellini et al., 2016; Geissdoerfer et al., 2017; Heshmati e Rashidghalam, 2021; Pascale et al., 2023; Corsini et al., 2023), numa tentativa de compatibilização do crescimento económico com a preservação dos ecossistemas e a redução da pressão ambiental (Domenech e Bahn-Walkowiak, 2019; Ghinoi et al., 2020 Silvestri et al., 2020; Heshmati e Rashidghalam, 2021; Kirchherr et al., 2023). Embora a investigação ao nível da esfera industrial seja extensa, constata-se um menor volume de investigação na área do turismo (Reike et al., 2018; Neves et al., 2019; Sorin e Sivarajah, 2021; Arsova et al., 2022; Gura et al., 2023; Niang et al,, 2023), questão especialmente preocupante no contexto das regiões ultraperiféricas, dada a fragilidade dos ecossistemas nestes territórios, a escassez de recursos críticos como a água, e a dependência dos mesmos do setor do turismo, dependência que acarreta com frequência processos de degradação ambiental (Guerra-Rodríguez et al., 2020).

Contudo, tanto o setor do turismo (setor intensivo na utilização de alguns recursos escassos, como a água), como a administração pública (outro setor predominante no contexto insular), oferecem um elevado potencial de emergir como modelos e exemplos de boas práticas no contexto de adoção da EC (Pascale et al., 2023). Os setores em causa, em especial o setor do turismo, oferecem as condições ideais para promover uma transformação organizacional e tecnológica generalizada, via *linkages* com fornecedores e outros *stakeholders*, desde que assegurado o background normativo e financeiro adequado.

O presente estudo centra-se da análise da adoção da EC no setor da hotelaria em Grã Canaria e na Região Autónoma da Madeira (RAM), de forma a identificar o ritmo de adoção, as barreiras percecionadas e as necessidades em termos de recursos (Grafström e Aasma, 2021; Veyssiére et al., 2022; Pascale et al., 2023). Julga-se assim ser possível compreender o envolvimento e comprometimento dos atores chave, (Gura et al., 2023), e perspetivar quais as áreas de intervenção prioritárias por parte dos governos regionais e dos municípios (Cahoon et al., 2013; Arnsperger e Bourg, 2016; Silvestri et al., 2020; Gemar et al., 2023).

A adoção da CE é vista por Healey (1997), Olesen (2013), Bolger e Doyon (2019) e Gura et al. (2023) como uma oportunidade para exercitar um planeamento estratégico que rompa com a ordem social existente, que se assuma como transformativo, que combata a ordem neoliberal, e que ofereça mais qualidade de vida, melhores oportunidades de negócio, e a preservação da biosfera local. Embora os objetivos geralmente sejam mais limitados, exige-se de qualquer forma informação e dados. Conquanto exista uma diversidade de estudos sobre implementação de uma série de indicadores compósitos para avaliar a taxa de sucesso na adoção da EC (Arnsperger e Bourg, 2016; Silvestri et al., 2020), escasseiam estudos que analisem o ritmo de adoção do lado da oferta ao nível micro, e que permitam sugerir iniciativas relativamente ao papel dos Governos Regionais. Daí que este estudo se centre em especial na identificação das taxas de adoção de diferentes tipos de medidas na área da EC ao nível do setor hoteleiro, no intuito de quantificar a dimensão das mesmas, e de identificar os "drivers" da adoção, nomeadamente no que concerne às atitudes dos diretores hoteleiros e às barreiras percecionadas.

O estudo em questão resulta da recolha de dados no âmbito de um projeto comunitário, a envolver as regiões das Canárias, Madeira e Açores. Tanto as Canárias como a Madeira assumem um papel de relevo no contexto do desenvolvimento turístico ao nível europeu, ao nível do turismo de massas (no caso das Canárias), e do turismo natureza (no caso da Madeira). Embora os resultados deste estudo reflitam a perspetiva da Grã-Canária e da Madeira, os mesmos afiguram-se de interesse (para efeitos de benchmarking), para outras regiões, confrontadas com escassez de recursos e predominância do turismo como setor chave. Este artigo estrutura-se da seguinte forma. A secção 2 oferece uma revisão da literatura. A seção 3 providencia alguns dados sobre a Grã-Canária e a Madeira como potenciais regiões-laboratórios na área da EC. A seção 4 discorre sobre a metodologia, a seção 5 discute os resultados obtidos, enquanto as conclusões constam da seção 6.

2-REVISÃO DA LITERATURA

A revisão de literatura, centrada nos termos "circular economy, circular economy, circular hotels, environmental practices, green practices e eco-innovations", permitiu constatar a existência de um número reduzido de estudos empíricos que permitam identificar taxas concretas de adoção e que se debrucem ao nível micro sobre a questão da adoção de medidas EC. Embora a noção de EC remeta para a questão da sustentabilidade ambiental e da gestão escassa de recursos, importa referir que, numa perspetiva mais estratégica, e concentrando o foco na componente económica, a noção de EC surge na agenda político-mediática dos países da União Europeia como uma tentativa de reindustrializar a União Europeia (Healey, 1997; European Commission, 2015; Geisendorf e Pietrulla, 2018; Niang et al., 2023), com base no desenvolvimento de setores competitivos, estratégicos e compatíveis com as necessidades de preservação do ambiente e com as preocupações por parte do eleitorado. Numa versão técnica e mais próxima do entendimento comum do conceito, a EC define-se como uma alternativa ao modelo de produção e consumo tradicional, do tipo *take-make-consume-dispose*, baseado na

extração de matérias-primas virgens, na produção, comercialização e consumo de produtos e na posterior eliminação dos mesmos, no final da vida útil, remetidos nalguns casos para aterros ou lixeiras industriais (Steffen et al., 2015; Beers et al., 2018; Gonçalves et al., 2021).

Dado a crescente escassez de matérias primas e a degradação do ambiente a ritmo acelerado em resultado da exploração mineira e dos processos industriais utilizados, frequentemente altamente poluentes, a alternativa é reduzir, reutilizar, reciclar e recuperar materiais nas fases de produção, distribuição, consumo e fim de vida, de forma a substituir o conceito de '*end-of-life'*, com a recuperação ou extensão do ciclo de vida, no intuito de atingir o "objetivo de desenvolvimento sustentável, sem descurar questões de qualidade ambiental, prosperidade económica e equidade social" (Kirchherr et al., 2017, 224–25; Ritcher et al., 2018; Refsgaard et al., 2021). Um dos objetivos da EC é o de reduzir o consumo per capita de recursos escassos, e os níveis de poluição e degradação ambiental decorrentes da produção de bens e equipamentos, através a adaptações inovativas, ao longo de toda a cadeia de valor (definido como "*narrowing*"), visando abrandar o ritmo de desgaste dos produtos através da extensão do ciclo de vida dos mesmos ("*slowing*") e fechar os ciclos de produção através da reciclagem e reutilização ("*closing*") (Bocken et al., 2016).

Constata-se uma falta de consenso no que concerne ao significado preciso do conceito de EC, o que obstaculiza e complexifica a análise do mesmo (Lieder e Rashid, 2015; Reike et al., 2018; Sacchi Homrich et al., 2018; Korhonen et al., 2018; Silvestri et al., 2020). Tendo em conta a diversidade de áreas científicas e paradigmas utilizados na análise do mesmo, não admira a pluralidade de focos de análise e a assunção de que se trata de um conceito pluridimensional, paradigmaticamente imaturo (Masi et al., 2018, 542) e contestado (Kirchherr et al., 2023, 2), não tanto na esfera técnica, mas sim nas visões normativas e nas expectativas relativamente ao evoluir da economia e da sociedade que derivam da discussão do mesmo. Ghisellini et al. (2016), Kirchherr et al. (2017), Candan e Toklu (2022) e Pascale et al. (2023) referem que o conceito de EC traduz uma realidade não-estática em constante evolução e mudança. Existe, contudo, um consenso que a EC oferece oportunidades na área ambiental, social, económica, através da gestão eficiente de recursos, poupanças de custos e redução das importações (Heshmati e Rashidghalam, 2021). A maioria dos especialistas também concorda que o conceito de EC releva a reciclagem, a regeneração e a restauração das matérias-primas escassas (Cother, 2020; Corsini et al., 2023), assim como a preservação do ambiente e o combate às alterações climáticas através de inovações ao nível da inovação, produção e consumo (Bolger e Doyon; 2019; Cother, 2020; Corsini et al., 2023; Gura et al., 2023).

A Comissão Europeia tem incentivado a adoção da CE através de um conjunto de programas, iniciativas e modelos financiamento (Silvestri et al., 2020), de forma a promover inovações na gestão do ciclo de recursos, nas vertentes da produção, consumo, gestão do lixo e mercado de resíduos e subprodutos (European Commission, 2019; Velenturf e Purnell, 2021; Corsini et al., 2023). Apesar da imposição de um quadro legal robusto, transcrito em métricas e medidas de política comuns, constata-se diferenças regionais marcantes em termos da dinâmica de adoção de medidas. Conforme referem Reike et al. (2018, 251), e também Sakai et al. (2011), constatam-se disparidades em termos de "ambição e taxas de reutilização". Silvestri et al. (2020) associam as divergências constatadas à existência de idiossincrasias regionais, o que sugere a necessidade de enfatizar a dimensão regional, na análise das práticas de adoção. O ângulo regional é sobretudo relevante no contexto da ultraperiferia, onde a questão de escassez de recursos é mais premente e onde o papel dos governos regionais surge como relevante devido ao grau de autonomia política e ao acesso majorado a fundos comunitários, tão importantes na sustentação do investimento público e privado. Ghisellini et al. (2016), Högstörm et al. (2018), Bolger e Doyon (2019), Arsova et al. (2022) atribuem às regiões e municípios um papel chave no apoio às empresas na transição para a CE (Chidakel et al., 2021).

A complexidade da transformação exigida, e os custos implícitos à mesma, implica uma colaboração e solidariedade interinstitucional entre os vários *stakeholders* privados e públicos (Henrysson e Nuur, 2021; Cother, 2020; Corsini et al., 2023), assim como a capacidade para mobilizar todos os intervenientes chave, com experiência critica no processo (CIRCTER, 2019), e/ou acesso a recursos financeiros ou legais (Opferkuch et al., 2021).

Arsova et al (2022) referem que a adoção da CE implica uma abordagem híbrida, que mistura abordagens do tipo *top-down* (relativa a planos de desenvolvimento e respetivos quadros legais e regulamentares, envolvimento do sistema político e da estrutura de *governance* e do contexto institucional em geral no apoio à inovação, incluindo subsídios) com iniciativas *bottom-up* (relativos às iniciativas da sociedade civil, e de determinados setores do meio empresarial, nomeadamente no que se refere à *shared-economy*, nas áreas da gestão do lixo e dos resíduos, assim como à pressão dos consumidores, turistas e eleitores) (Ghisellini et al., 2016; Prendeville et al., 2016; Gravagnuolo et al., 2019; Vanhamäki et al., 2020; Poponi et al., 2020; Sánchez et al., 2020;; Henrysson e Nuur, 2021; Corisni et al, 2023). No que se refere à EC, existe a capacidade a nível regional (e em certa medida, a municipal) de identificar as preferências dos empresários locais, em termos das iniciativas a implementar, e de adaptar a legislação e os programas comunitários em conformidade com as referidas preferências, para além de poder prever e modular subsídios e taxas ecológicas (Heshmati e Rashidghalam 2021; Veyssiére et al., 2022).

Geissdoerfer et al. (2017), Vanhamäki et al. (2020) e Guerra-Rodríguez et al. (2020) indicam que sucesso no âmbito de uma adoção generalizada da EC implica um modelo e plano de transição, a par da cooperação entre diferentes *stakeholders* (empresas, estado (local, regional e nacional), baseado em boas práticas, questão sempre complexa em territórios de baixa densidade empresarial povoados por micro-empresas e PMEs com baixa capacidade de auto-financiamento (Pascale et al., 2023; Cahoon et al., 2013; Spatial Foresight et al., 2017; Refsgaard et al., 2021; Opferkuch et al., 2021; Richter e Christmann, 2023; Schmieder et al., 2023).

Apesar do papel imprescindível dos governos regionais e dos municípios na definição do quadro regulamentar e nos apoios financeiros a projetos de investimento, em última análise, as decisões de investimento respeitam às empresas, que terão de identificar problemas e soluções e financiar os investimentos requeridos, em especial no que se refere a iniciativas não obrigatórias do ponto de vista legal. Diversos estudos referem a questão do acesso a recursos financeiros (medido através do *cash flow*), e da capacidade de autofinanciamento e de investimento por parte das empresas, em soluções *EC-friendly*, como um fator determinante do ritmo de inovação (Czarnitzki e Hottenrott, 2011). Contudo a componente de colaboração em rede assume também um papel importante. No caso das ilhas em geral, e das RUPs em particular, o setor do turismo assume uma importância primordial, no estabelecimento de *linkages* com os restantes setores da economia (Yang et al., 2018; Chidakel et al., 2021; Gemar et al., 2023), pelo que se entende que cabe ao setor da hotelaria um papel de líderes na adoção de medidas EC, através da pressão exercida sobre fornecedores e clientes para adotarem medidas compatíveis com a política ambiental da empresa.

Embora o desenvolvimento da EC assente numa forte componente legal, política e mediática e ambiental, Cother (2020) refere que a adoção da EC implica o reconhecimento da componente da sustentabilidade económica, relativa à rentabilidade dos investimentos, que venham a ser concretizados nas vertentes de redução do consumo de recursos, minimização de produção de resíduos e lixo, redução de custos de produção e ganhos de produtividade. As PMEs necessitam também de apoio em termos de informação prática e à medida das necessidades, assim como análises custo-benefício que salientem as vantagens da EC, dado que pode ser mais conveniente para uma empresa comprar matérias-primas virgens (Neves et al., 2019), do que materiais reciclados (ou resíduos e lixo) (Dong et al., 2017). Mais, o custo do investimento inicial pode ser proibitivo, assim como o impacto de outras barreiras à entrada (Kirchherr et al., 2018).

Noutros casos, as PMEs manifestam dificuldades em identificar e compreender oportunidades de negócio na área ambiental (Corsini et al, 2023), faltando muito frequentemente às PMEs as capacidades internas de análise dos prós e contra no que se refere à adoção de medidas EC. Compete neste caso às autoridades regionais reduzir os custos de investimento e partilhar informação relevante, através dos organismos competentes. Grafström e Aasma (2021), Kirchherr et al. (2018) e Pascale et al. (2023) identificam 4 tipos de barreiras, a saber, tecnológicas, de mercado, institucionais e do tipo regulatórias e sociais e culturais, que devem ser analisadas pelas autoridades regionais, no intuito de estabelecer programas de apoio adequados, baseados em boas práticas (Arnsperger e Bourg, 2016; Cother, 2020; Veyssiére et al., 2022; Gura et al., 2023).

Como as regiões e os municípios tem capacidade de aplicação de medidas práticas de curto prazo e estratégicas, os mesmos necessitam de implementar medidas de monitorização e de apoio

atores chave, de forma a evitar abordagens fragmentadas e casuísticas (Kirchherr et al., 2018; Bolger e Doyon, 2019; Cother, 2020; Gura et al., 2023). A análise das barreiras e dos desafios enfrentados pelas empresas (Kirchherr et al., 2018; Cother, 2020), continua a ser um tema relevante, apesar da diversidade de medidas de apoio. As suscetibilidades, em termos de atitudes e comprometimento com a causa ambiental dos responsáveis das empresas, e as motivações dos mesmos, constituem também temas importantes. A transição para modelos de negócio EC não constitui um processo de aplicação fácil, dado implicar uma mudança de paradigma (Corsini et al., 2023), e uma alteração do modelo de negócio.

Uma das questões referidas na literatura, em termos de barreiras, refere-se à questão do financiamento, conforme referido acima. Meili e Stucki (2023) mostram que o sistema bancário desempenha um papel fundamental na difusão da EC, dadas as necessidades de financiamento implícita na adoção de modelos de negócio mais ecológicos. Os instrumentos de financiamento constituem um dos *drivers* mais decisivos, assim como o acesso a subsídios e incentivos fiscais. O *procurement* publico, e o volume de "cash flows" das empresas, o que nos remete para a rentabilidade e viabilidade económico-financeira das empresas, impacta também claramente a probabilidade de adoção (Heshmati e Rashidghalam, 2021).

Entre os fatores facilitadores importa ter em conta que a motivação e as convicções dos gestores e diretores acabam por ser os fatores relevantes, em adição à existência de uma equipa dedicada á analise da EC em termos das oportunidade e investimento necessários. A prática de introduzir inovações é também uma questão relevante, assim como a possibilidade de identificar benefícios e resultados rapidamente (Saarinen e Aarikka-Stenroos, 2022). Embora existam muitas soluções tecnicamente viáveis, as mesmas podem não ser financeiramente ou comercialmente sustentáveis num determinado território.

Questões de competência técnica terão de ser tidas em conta, assim como as prioridades e as restrições temporais das empresas (Cother, 2020). Condicionantes culturais e mediáticas transcritas na perceção da EC como "*a nice thing to do*", ou como um ótimo slogan comercial (Candan e Toklu, 2022), mas não necessariamente uma prioridade do modelo de negócios, também devem ser tidas em conta (Cother, 2020).

De facto, as necessidades operacionais do dia a dia podem induzir as empresas a desenvolver os esforços nesta área "fora de horas", com recurso a trabalho extraordinário e ao entusiamo de determinados funcionários, o que pode desmobilizar a prazo os recursos humanos afetos à implementação de medidas. Assiste-se por outro lado com frequência à resistência interna à mudança, o que pode desanimar os líderes. Dong et al. (2017), Gonçalves et al. (2021), Arbolino et al. (2020) e Kirchherr et al., (2017) referem ainda papel das redes e sistemas industriais, como fatores potenciadores, o que no caso do setor do turismo, conforme referido acima, pode contribuir para a difusão da EC através da rede de fornecedores e clientes.

3-CONTEXTO DA INVESTIGAÇÃO

A questão da escassez de recursos, e a necessidade de depender de energias não renováveis (Arsova et al., 2022; Gura et al., 2023; Candan e Toklu, 2022), coloca-se com especial acuidade nas regiões ultraperiféricas (RUPs), que englobam as Canárias, Madeira, Açores, Guina Francesa, Martinica, Guadalupe e Reunião, dado o menor volume de recursos disponíveis para gerir crises como catástrofes naturais (Ismeri, 2011a; IPCC, 2014; Candan et al., 2022).

A vulnerabilidade das RUPs, expressa na "predisposição para sofrer impactos negativos de origem externa" (Ismeri, 2011a, 13; 2011b) resulta da dependência da dinâmica económica global, (nomeadamente no que concerne à sua dependência do setor do turismo), mas também da sua localização periférica conducente a custos de transporte acrescidos, do rácio exportações/importações desfavorável e da reduzida diversificação do tecido económico e da exposição crescente aos riscos naturais a impactar um território reduzido.

A dependência destas regiões das importações de matérias-primas essenciais e das exportações de serviços coloca-as sujeitas aos riscos decorrentes de disrupções nas importações e no comércio internacional e da instabilidade nos preços (Bayon, 2007; Ismeri Europa, 2009), para além do impacto das alterações climáticas em ecossistemas marítimos e costeiros frágeis. As RUPs

necessitam, portanto, de modelos de desenvolvimento alternativos, focados na otimização do valor dos recursos naturais, e na utilização racional dos recursos, pelo máximo período de tempo possível, minimizando os resíduos e o lixo, o que nos remete de imediato para o conceito de EC.

As RUPs devem preservar 3 tipos de capital (Pascal et al., 2023) para manterem os níveis atuais de desenvolvimento turístico. A manutenção do stock de capital natural, depende da disponibilidade de recursos, mas também da taxa de utilização, renovação e conservação dos mesmos, e da capacidade para operar dentro dos limites da capacidade de carga dos ecossistemas (DesRoches, 2018). Obviamente que a reciclagem de recursos evita a degradação do stock de recursos. De acordo com Pascal et al. (2023) a reutilização, renovação e reciclagem pode ser interpretada como um investimento em capital natural. A manutenção do stock de capital económico implica acesso a recursos naturais, e um sistema de *governance* que permita produzir bens e serviços que rentabilizem os investimentos, numa lógica sustentável. O aumento do stock de capital económico (leia-se por exemplo investimento no setor da hotelaria) depende da qualidade do stock de recursos naturais e da oferta de amenidades e outros equipamentos e serviços conducentes a experiências satisfatórias, dado a procura turística (e o investimento em novos estabelecimentos hoteleiros) assentar essencialmente neste último.

O capital social, expresso através dos ativos intangíveis como uma visão e inteligência coletiva e nível de capital humano, afigura-se fundamental para assegurar níveis elevados de bem-estar na comunidade, e a capacidade de colaboração e *estabelecimento de redes*, input fundamental da função de produção (Anand e Sen, 2000), e sobretudo de decisões racionais entre *stakeholders* (Meadows, 1998; Kwok et al., 2019).

Outro aspeto a ter em conta. Gössling e Rutten (2007) e Meili e Stucki (2023) mostram que o nível de rendimento regional expresso pelo poder de compra familiar e pelo volume de *cash flows* influencia a capacidade de adoção de inovações de uma região. Mais, maiores índices de poder de compra (e de PIB *per capita*), atraem mais mão de obra qualificada, capacitada para liderar a inovação ao nível empresarial. As ilhas Canária e sobretudo a Madeira exibem algumas lacunas neste respeito, como a tabela seguinte demonstra.

Quadro 1: Dados chave sobre as Canárias e a Madeira

	Ano	Canárias	Espanha	Madeira	Portugal	
PIBpreçoscorrentes/€/hab	2021	19000	25500	19300	20800	€
PIB/hab/média UE		74,51%		92,79%		i/P
	2000-2021	0,94%	2,24%	2,63%	2,45%	tcma
	2021	59	74	60	64	EU
€/hab PPC	2021	20100	27000	22500	24300	€
	2000	17500	17900	14000	15700	€
Chegadas Turistas	1990	2265261	35325699	430530	8835198	hospedes
	2022	13309928	133044709	1572230	27337455	hospedes
	1990-2022	5,69%	4,23%	3,73%	4,13%	tcma
	2022/1990	5,876	3,766	3,651	3,233	Vf/Vi
População	2022	2252237	47432893	251182	10352042	hab.
	1990	1483529	38853227	256610	9995945	hab.
	1990-2022	1,31%	0,63%	-0,07%	0,11%	tcma
Área	2022	7445	505944	802	92226	km^2
Chegadas/Área	2022	1787,767	262,963	1960,387	296,418	racio
	1990	304,266	69,821	536,820	95,799	racio
Chegadas/população	2022	5,910	2,805	6,259	2,641	racio
	1990	0,655	1,100	0,596	1,131	racio

Fonte: Dados Eurostat. Legenda: Vf/Vi (Valor Final (2022)/Valor Inicial (1990); i/P (valor na região i(Canárias; Madeira) em função do valor do país de referência P (País (Espanha; Portugal)); tcma (taxa de crescimento anual composta)

O Quadro 1 demonstra que as Canárias e a Madeira exibem valores do PIB per capita abaixo da média comunitária, 59% no caso das Canárias e 60% no caso da Madeira. Dado que o crescimento populacional registado no período 1990-2022 é modesto, e dado que o crescimento no número de chegadas é significativo, a saber de 5,69% e 3,73% ao ano, não admira que a pressão em termos do número de turistas por habitante e Km^2 tenha aumentado de forma significativa, e, portanto, e por arrasto, o consumo de recursos escassos como a água (IPCC, 2014). Os dados do Quadro 1 indicam que o rácio chegadas/população evoluiu de 0,655 (0,596) hospedes por habitante, em 1990, para 5,910 (6,259), em 2022, nas Canárias e na Madeira. Embora, o setor do turismo permita a ambas as regiões aliviar a "poluição da pobreza" (Sharpely, 2003, 248), a

expansão do mesmo registada nas últimas décadas afigura-se crescentemente insustentável (Majdak e Almeida, 2023).

4-METODOLOGIA

Conforme indicado na introdução, faltam estudos ao nível regional, sobretudo no que concerne à ultraperiferia, no que se refere à EC (Ismeri, 2011a). Idem para estudos ao nível das preferências, motivações e barreiras ao nível do setor da hotelaria (Masi et al., 2018). Pelas razões expostas acima, na revisão de literatura, este estudo concentra-se em identificar o grau de adoção de uma série de medidas práticas (ex. adoção de "torneiras com temporizador ou ativação por sensor") na área da EC, assim como a perceção dos diretores de estabelecimentos hoteleiros relativamente à importância da EC e à relevância das barreiras percecionadas, de forma a quantificar e caracterizar os contornos da adesão e das barreiras à adoção de medidas.

Neste estudo opta-se por uma abordagem quantitativa, via questionário, para a recolha de dados, junto de uma amostra de hotéis de 2, 3, 4 e 5 estrelas, dado o interesse em obter valores indicativos e quantitativos da taxa de adoção junto de empresas que constituem um referencial para o setor. A amostra não inclui, portanto, unidades hoteleiras como pousadas ou unidades de alojamento local. A definição do processo de recolha envolveu três fases: *design* do questionário baseado na literatura, um trabalho exaustivo de forma a identificar o máximo de potenciais práticas (via inventariação das medidas aplicáveis de forma a obter uma visão global da dinâmica de adoção, numa perspetiva prática); recolha de dados; e análise e discussão dos resultados.

Relativamente à primeira fase, importa referir que as questões incluídas no questionário resultam de questões previamente incluídas e validadas noutros estudos. A pertinência das mesmas foi adicionalmente validada com recurso à opinião de peritos e empresários do setor em Grã-Canária, com vasta experiência na adoção de medidas inovadores no campo da sustentabilidade ambiental, do que resultaram alterações pontuais na fraseologia e conteúdo das questões. A recolha de dados decorreu no início de 2022, em ambas as regiões. Dado que o processo de recolha envolveu com frequência um contacto direto com o diretor do hotel, constatou-se não existirem problemas relevantes de interpretação do conteúdo do questionário. O questionário inclui questões sobre as práticas na área da água, resíduos, e política de pessoal e RSC, áreas relevantes no contexto do setor hoteleiro, barreiras e razões para a não adoção de medidas, e questões relativas ao perfil das empresas, baseando-se em Menegaki e Damingos (2018), Florido et al. (2019), Rodríguez-Antón e Alonso-Almeida (2019), Rodríguez-Espíndola et al. (2022) e Rodríguez et al. (2020).

Embora se dispusesse de uma base de dados com contactos do setor da hotelaria, as dificuldades na recolha de dados na fase inicial com base numa abordagem integralmente aleatória via envio de *email*, levaram os autores deste estudo a optar por uma abordagem mais pessoal através do reenvio de *emails*, junto com nota explicativa adicional dos objetivos da investigação e da relevância social da mesma, seguido de contacto pessoal, nos casos de respostas positivas. O processo de recolha de dados constitui, portanto, uma mistura do método probabilístico com um *snowballing effect*, dado ter sido solicitado aos diretores hoteleiros apoio no contacto com colegas. No total, considerando as duas regiões, foram obtidos 90 questionários. Trata-se de uma amostra relativamente reduzida (Masi et al., 2018), pelo que os resultados devem ser lidos como indicativos, mas próxima do número ideal de 118 questionários, tendo em conta a dimensão da população de hotéis, e suficientemente alargada para sustentar conclusões e recomendações (Sánchez Levoso et al., 2020).

A análise de resultados inclui uma análise das taxas de adoção e atitudes dos diretores hoteleiros em termos de percentagem e de médias, mas também uma análise econométrica dos fatores explicativos das taxas de adoção. Neste estudo a variável dependente é definida como um rácio entre o número efetivo de medidas adotadas e o número máximo de medidas identificado no questionário para cada subárea. Dado que a variável dependente é definida como um índex continuo limitado pelos números extremos de 0 e 1, o modelo OLS não é apropriado dado admitir valores preditos negativos, nem a regressão beta, dado existirem taxas de adoção nulas e a 100% (Assmann e Ehrl, 2021). O modelo *´fractional logit´* permite modelizar variáveis-rácio (Ramalho

et al., 2011), calcular efeitos marginais variáveis, e acomodar distribuições heteroscedasticas (Papke e Wooldridge, 1996), pelo que é selecionado neste estudo para identificar as variáveis explicativas da taxa de adoção medida como rácio. Em termos de variáveis explicativas consideramos dados relativos ao perfil das empresas, a atitude dos inquiridos sobre o seu grau de comprometimento com a agenda EC, e perceção sobre as barreiras à adoção.

5-RESULTADOS

A amostra inclui 90 empresas no total. A taxa de adoção expressa pelo rácio medidas adotadas versus total de medidas, em quatro áreas diferentes, sugere avanços relevantes na área da reciclagem, com 65% das medidas adotadas, seguindo-se a área da energia e água, com uma taxa média de adoção de 48%. Medidas que respeitam à sustentabilidade de forma genérica (28%), e à qualificação do pessoal e RSC (26%), são executadas a um ritmo muito mais reduzido. No Quadro 2 podemos observar mais dados sobre o perfil dos inquiridos e das empresas e sobre a atitude dos inquiridos em termos de objetivos, motivações e práticas.

Quadro 2: Estatísticas-chave da amostra

Perfil sociodemográfico dos diretores de hotel ou equivalente		
Idade	Media de 43,6 anos	36-45 anos (37,8%)
Cargo	63,3% diretores	
Habilitações Académicas	83,3% com licenciatura	Bacheralato (14,4%)
Perfil dos Estabelecimentos Hoteleiros		
Nº de Quartos	Média de 160 quartos	51-125 (27,8%)
Nº de Camas	Média de 331 camas	101-250 (27,8%)
Antiguidade	25,2 anos	desde 2011 (27,8%)
Independente	36,4% independente	62,8% cadeia
Modelo Gestão	Propriedade própria (76,/%)	Contrato de gestão (22,2%)
Tipologia	4 estrelas (44,4%)	5 estrelas (23,3%)
Mercado	Tipo "Sol e Praia" (55,56%)	Tipo Urbano (27,8%)
Objetivos		
Exigência do tour operator	Média de 3,022	dev. pad. = 1,349; "5" 16,67%
Reforço da imagem de marca	Média de 4,222	dev. pad. = 1,014; "5" 50,00%
Responder à pressão dos clientes	Média de 3,722	dev. pad. = 1,102; "5" 33,33%
Redução de custos	Média de 3,922	dev. pad. = 1,183; "5" 41,11%
Estratégia empresarial	Média de 4,089	dev. pad. = 1,067; "5" 44,44%
Outras razões	Média de 3,000	dev. pad. = 1,529; "5" 26,67%
Motivações e prática		
Desenvolveu/aplicou medidas EC nos últimos 3 anos? (max 6)		Média de 3.711
Grau de comprometimento com gestão da água e energia (1-5)		Média de 3.911
Grau de comprometimento com reciclagem (1-5)		Média de 4.100
Grau de comprometimento com sustentabilidade (1-5)		Média de 3.822
Grau de comprometimento com meio ambiente (1-5)		Média de 3.967
Taxa de adoção medida Água e energia (max de 27 medidas)		48%
Taxa de adoção medida Reciclagem (max de 12 medidas)		65%
Taxa de adoção medida Sustentabilidade (max de 17 medidas)		28%
Taxa de adoção medida Pessoal e RSC (max de 15 medidas)		25%

Legenda: Clas. "5", indica a categoria máxima na escala de Likert.

O perfil dos inquiridos aponta para uma média de idades de 44 anos, e para a licenciatura como background académico mais frequente. Relativamente às unidades hoteleiras, os dados sugerem uma média de 160 quartos por unidade hoteleira, com o predomínio do modelo de "propriedade própria", e uma antiguidade no mercado a rondar os 25 anos. Relativamente às razões ou objetivos prosseguidos constata-se a importância do reforço da imagem de marca (classificação de 5, por parte de 50,0% dos inquiridos), seguido da relevância da EC na estratégia empresarial. A pressão dos clientes é moderada, com apenas 33,% dos inquiridos a considerá-la como muito importante. Relativamente às barreiras à adoção das medidas, na fase de implementação, constata-se serem

os "custos elevados de implementação e o custo associado ao cumprimento dos standards" como a razão chave mais predominante ($\bar{x}$=3,84; σ=1,12; "clas. 5=33,3%). Segue-se a questão da burocracia associada à adaptação das medidas ($\bar{x}$=3,54; σ=1,29; "clas. 5=27,8%). As "dificuldades para obter financiamento para pôr no terreno as medidas" surgem em terceiro lugar ($\bar{x}$=3,39; σ=1,28; "clas. 5=24,4%). Relativamente às barreiras na fase pré-adoção, os resultados são relativamente similares. O facto "custos elevados" surge como o fator chave ($\bar{x}$=3,79; "clas. 4+5=68,9%), seguido dos fatores burocracia ($\bar{x}$=3,44;"clas. 4+5=52,2%) e "acesso a financiamento" ($\bar{x}$=3,34;"clas. 4+5=50,0%). O grau de correlação é elevado no que concerne à perceção das barreiras na fase pré e fase implementação (ρ= 0,8917; p=0,000).

Quanto à atitude dos inquiridos, expresso pelas respostas às questões relativas ao grau de compromisso com a (1) "gestão da água e energia", (2) "práticas de reciclagem adotadas no seu estabelecimento hoteleiro" e (3) "a política de recursos humanos e RSC", as médias computadas e expostas no Quadro 2 são relativamente elevadas. O grau de correlação relativo às três áreas analisadas é também elevado ($\rho_{(1)(2}$ = 0,7268; p=0,000, $\rho_{(1)(3)}$= 0,7441; p=0,000, $\rho_{(2)(3)}$= 0,7973; p=0,000), o que sugere uma adoção em cadeia.

Dado o estudo abarcar 4 áreas de intervenção (água e energia; resíduos; sustentabilidade; e pessoal e RSC), procuramos identificar os fatores explicativos da taxa de adoção (de 0 (zero medidas adotadas) a 1 (totalidade das medidas indicadas adotadas)) registada em cada caso, tendo em conta as variáveis identificas na revisão da literatura, para além do impacto das variáveis em causa no total das medidas.

Testes preliminares (*ttest*, ANOVA, correlação de *Spearman*, e análise de diferentes soluções em termos do conjunto das variáveis explicativas) permitiram reduzir o leque de variáveis explicativas de interesse, nomeadamente no que concerne às variáveis de controlo. Cite-se a título de exemplo as variáveis relativas ao perfil das empresas e empresários, caracterizadas por diferenças de médias estatisticamente não significativas, falta de impacto depois comprovada em análises preliminares dos modelos.

Considerando apenas os resultados obtidos para a variável "Total" (Ver Quadro 3 para mais detalhes), constata-se uma relação inversa entre a dimensão do hotel e a percentagem de adoções. Constata-se ainda que quanto maior o número de inovações genéricas adotadas na área EC, maior o total de medidas especificas adotadas. A "pressão de clientes" e problemática da redução de custos não surgem como estatisticamente significativas, a não ser no caso da adoção de medidas na área do "pessoal e RSC". Em termos de *drivers*, o registo de adoções aparece associado à "estratégia empresarial". Em linha com expectativas, quando maior a perceção da existência de barreiras na fase de implementação de medidas na área EC, menor o número de medidas adotadas. Curiosamente, quer a burocracia quer as dificuldades de financiamento parecem não impedir a estratégia corporativa na área EC, expressa no número de adoções. Contudo a questão dos recursos aparece expressa no facto da variável "hotel de 2 estrelas" impactar negativamente o número de adoções. Ou seja, embora os responsáveis pelos hotéis de 4 e 5 estrelas possa ignorar o impacto da burocracia e dos custos financeiros, o mesmo não se constata no caso dos hotéis com menores recursos. Os limites externos definidos como relativos à incapacidade das unidades hoteleiras para reciclar maior volume de resíduos, devido a razões como a falta de contentores ou falta de pressão por parte de clientes e *tour operators* afetam negativamente, em linha com as expectativas, o ritmo de adoção. O grau de comprometimento com a agenda EC aparece como fundamental em qualquer uma das áreas analisadas, impactando positivamente a taxa de adoção.

No Quadro 4 podemos observar os efeitos marginais subjacentes às regressões estimadas. Dado ter sido destacado neste estudo papel do Estado, via governos regionais e câmaras municipais, consideramos em particular o impacto da variável "limites externos", dada a mesma respeitar a iniciativas que competem às câmaras municipais, como a disponibilização de contentores. No caso em apreço, um aumento em 1% na média computada relativamente aos limites percecionados pelos inquiridos, traduz-se numa redução na taxa de adoção em 0,119. Quanto maior o nível de acesso a contentores, a eficiência dos serviços de reciclagem concelhio, a certeza sobre a eficiência do processo técnico de reciclagem, e menor os custos de tratamento dos resíduos, maior a taxa de adoção. Em linha com Heshmati e Rashidghalam (2021), Veyssiére et al. (2022) e Meili e Stucki (2023), constata-se espaço para intervenção por parte dos serviços municipais, no sentido de incrementar os recursos ao dispor dos hotéis, e a atitude positiva dos

mesmos relativamente à capacidade de apoio por parte das autoridades municipais. Intervenções que permitam reduzir o nível das barreiras na fase de implementação em 1%, traduzem-se em aumentos da taxa de adoção em 0,316, o que sugere novamente oportunidades de intervenção ao nível regional na área do acesso aos subsídios, financiamento de medidas, e outros em linha com Schmieder et al. (2023), Heshmati e Rashidghalam (2021) e Meili e Stucki (2023).

Quadro 3: Fractional logit: variável dependente taxa de adoção

	Total		Água&Energia		Residuos		Sustentabilidade		Pessoal e RSC	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
Certificação	0,027	0,749	**0,191**	**0,081**	-0,104	0,634	-0,055	0,727	-0,088	0,686
Nº Camas	**-0,042**	**0,097**	-0,041	0,147	-0,078	0,239	-0,048	0,357	-0,070	0,147
Hotel 2 estrelas	**-0,297**	**0,062**	**-0,468**	**0,011**	-0,201	0,578	-0,210	0,393	-0,268	0,290
Inovações	**0,073**	**0,005**	**0,083**	**0,024**	**0,164**	**0,011**	0,021	0,666	**0,138**	**0,010**
Pressão Clientes	0,054	0,120	0,048	0,310	-0,010	0,927	0,059	0,337	**0,191**	**0,005**
Redução Custos	-0,041	0,210	-0,053	0,242	-0,004	0,962	-0,065	0,286	-0,071	0,261
EstratégEmpresarial	**0,092**	**0,029**	**0,143**	**0,012**	0,095	0,401	0,113	0,126	0,055	0,507
Outras Pressões	-0,040	0,152	-0,040	0,204	-0,003	0,958	-0,064	0,207	-0,064	0,262
Custos Burocracia	**0,088**	**0,037**	**0,109**	**0,022**	0,064	0,404	0,123	0,151	0,139	0,118
Custos Implementar	-0,022	0,671	-0,016	0,789	0,088	0,512	-0,075	0,460	-0,071	0,538
Difi. Financiamento	**0,061**	**0,089**	**0,116**	**0,006**	-0,009	0,928	0,093	0,176	0,067	0,471
Barreiras Pós	**-0,283**	**0,039**	**-0,325**	**0,086**	**-0,611**	**0,094**	**-0,401**	**0,060**	-0,189	0,471
BarreirasPré	0,167	0,224	0,163	0,342	0,458	0,168	0,258	0,221	-0,002	0,993
Limites Externos	**-0,136**	**0,005**	**-0,202**	**0,001**	-0,133	0,331	**-0,171**	**0,098**	-0,125	0,184
Apoio Municipal	-0,030	0,341	-0,029	0,512	-0,093	0,296	0,007	0,912	-0,085	0,171
Comprometimento	**0,223**	**0,000**	**0,203**	**0,001**	**0,404**	**0,002**	**0,192**	**0,025**	**0,349**	**0,000**
_cons	**-1,243**	**0,000**	**-1,048**	**0,008**	-1,024	0,190	**-1,044**	**0,057**	**-1,973**	**0,002**
Wald Chi2;Prob>chi2	Chi2=134.83;p=0.000		Chi2=173.06;p=0.000		Chi2=51.54;p=0.000		Chi2=39.29;p=0.001		Chi2=84.63;p=0.000	
Pseudo R2;Log	R2=0.665;Log=-54.962		R2=0.102;Log=-55.942		R2=0.144;Log=-50.026		R2=0.051;Log=-50.619		R2=0.143;Log=-43.421	

Quadro 4: Fractional logit: efeitos marginais (elasticidades)

	Total		Água&Energia		Residuos		Sustentabilidade		Pessoal e RSC	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
Certificação	0,005	0,749	**0,033**	**0,081**	-0,015	0,638	-0,009	0,725	-0,013	0,684
NºCamas	**-0,051**	**0,093**	-0,051	0,144	-0,085	0,247	-0,053	0,349	-0,068	0,140
Hotel2	**-0,007**	**0,022**	**-0,012**	**0,001**	-0,006	0,570	-0,005	0,336	-0,005	0,213
Inovações	**0,100**	**0,005**	**0,111**	**0,023**	**0,179**	**0,009**	0,027	0,667	**0,158**	**0,013**
Pressão Clientes	0,072	0,122	0,063	0,309	-0,011	0,927	0,071	0,343	**0,205**	**0,005**
Redução Custos	-0,056	0,208	-0,073	0,241	-0,005	0,962	-0,081	0,282	-0,077	0,256
EstratégiaEmpresarial	**0,135**	**0,028**	**0,210**	**0,012**	0,120	0,399	0,151	0,127	0,064	0,508
Outras Pressões	-0,042	0,149	-0,043	0,205	-0,003	0,958	-0,060	0,196	-0,051	0,251
Custos Burocracia	**0,107**	**0,037**	**0,136**	**0,021**	0,073	0,401	0,138	0,157	0,132	0,119
CustosImplementação	-0,030	0,671	-0,022	0,789	0,107	0,511	-0,091	0,461	-0,073	0,536
Difi. Financiamento	**0,071**	**0,089**	**0,139**	**0,005**	-0,010	0,928	0,099	0,181	0,060	0,472
Barreiras Pós	**-0,316**	**0,037**	**-0,374**	**0,084**	**-0,636**	**0,089**	-0,409	0,056	-0,163	0,470
Barreiras Pré	0,184	0,223	0,184	0,339	0,467	0,160	0,259	0,222	-0,002	0,993
LimitesExternos	**-0,119**	**0,005**	**-0,182**	**0,001**	-0,110	0,330	**-0,135**	**0,093**	-0,082	0,180
ApoioMunicipal	-0,044	0,341	-0,043	0,512	-0,125	0,300	0,009	0,912	-0,096	0,167
Comprometimento	**0,312**	**0,000**	**0,285**	**0,001**	**0,489**	**0,001**	**0,245**	**0,028**	**0,393**	**0,000**

Os resultados sugerem que a pressão do lado da procura é reduzida, exceto no que se refere à área de pessoal e RSC, porventura em resultado da imagem sustentável do destino na mente dos consumidores, no caso da RAM. A baixa taxa de adoção nas áreas da sustentabilidade e do pessoal e RSC reportado no Quadro 2 sugere um papel para as autoridades públicas, na oferta de formação e programas de subsídios, nestas áreas em linha com Opferkuch et al., (2021), Heshmati e Rashidghalam (2021) e Veyssiére et al, (2022). Ações que promovam boas práticas neste âmbito poderão ser uma mais-valia nesta área.

A não significância estatística das variáveis associadas à questão da redução dos custos, a par do facto de 44% das empresas afetar 1-5% da faturação anual à aplicação de medidas na área da EC, valor modesto, dado o montante dos valores iniciais exigidos, mas eventualmente suficiente para satisfazer as necessidades de investimento na área remete-nos para a importância da

resource-based view na análise da questão, em linha com Corsini et al (2023) e Meili e Stucki (2023). Mais, o impacto das variáveis Custos da Burocracia e Dificuldades de Financiamento surgem com o sinal "oposto" às expectativas, dado a maior sensibilidade à questão das dificuldades de financiamento surgir associado a níveis maiores de adoção. Constata-se ainda uma relação negativa entre o número de adoções e a dimensão do hotel, também contra as expectativas. Uma explicação possível pode residir no facto da maior experiência na adoção de diferentes medidas e iniciativas incrementar a sensibilidade dos inquiridos para as dificuldades reais quer em termos de financiamento quer em termos do impacto da burocracia. Constata-se também que a adoção ao nível empresarial é afetada por vários obstáculos. Quanto maior o acesso a recursos (competências técnicas, recursos financeiros, experiência na adoção de inovações, etc), maior a probabilidade de sucesso nesta área. O impacto positivo da variável "inovação" no total de medidas adotadas fundamenta a apreciação retida neste ponto. Contudo, quanto maior experiência na área EC, maior o grau de consciência relativamente aos custos incorridos, contrabalançado pelo grau de envolvimento dos inquiridos. As motivações dos líderes das empresas, tal como explicitado por Pascale et al. (2023) e Kirchherr et al. (2023) são fundamentais para motivar as empresas a inovar ainda mais (Geddes e Schmidt, 2020; Hadfield e Coenen, 2022), e para adotar o máximo de inovações, como se constata neste estudo.

Assiste-se a um consenso na sociedade sobre a necessidade de reduzir os desperdícios e consumo de recursos (Veyssiére et al., 2022, 1192), mesmo que o nível de consciencialização por parte dos turistas possa ser momentaneamente suspenso durante a estada (Sörqvist e Langeborg, 2019; Mkono, 2020; Lubowiecki-Vikuk et al., 2021). Dado que a pressão dos consumidores não surge como significativa, o envolvimento dos consumidores parece baixo, o que sugere a necessidade de um estudo do lado da procura para identificar as razões para a falta de pressão.

Algumas notas adicionais em termos de discussão dos resultados. Não deixa de ser relevante que a taxa de entusiasmo com a EC é elevada sem ser entusiástica, o que nos remete para a problemática da adoção de medidas EC ser uma "*nice thing to do*", numa vertente focada no reforço da imagem de marca, numa lógica racional em linha com o desenvolvimento estratégico das empresas, eventualmente em antecipação às tendências de mercado. A variável redução de custos não surge como relevante. Contudo muitas empresas continuam motivadas por questões de rentabilidade e de lucro em decorrência da adoção de *growth-centric models* (Heshmati e Rashidghalam, 2021), o que justifica o papel atribuído ao reforço da imagem de marca, no caso das empresas analisadas, em linha com as conclusões de Savini (2023) e Sorin e Sivarajah (2021). A poupança de custos e no aumento de rentabilidade não surge, portanto, como a motivação-chave, embora na prática as vantagens neste campo acabem por ser internalizadas pelas empresas, e verbalizadas através do item "estratégia empresarial".

Conforme referido acima, o comportamento das empresas-chave, neste caso o setor da hotelaria, pode impactar o comportamento dos fornecedores, obrigando-os a adotar medidas na área. Corsini et al. (2023), Bacová et al. (2016) e Sorin e Sivarajah (2021) referem que os governos regionais assumem um papel chave no lançamento de iniciativas, na mobilização de *stakeholders*, e na promoção e financiamento de mudanças de paradigma. O mesmo pode ser referido para as empresas no setor do turismo. Dadas as diferenças constatadas a nível regional, entre as duas regiões em termos de contexto, necessidades e oportunidades, a política comunitária deve ser redefinida a nível regional, assumindo diferentes necessidades de apoio, em linha com o nível de desenvolvimento atual. Sobre as questões dos recursos, Silvestri et al. (2020) demonstram que as regiões com maiores níveis de PIB *per capita* reportam maiores níveis de implementação, o que sugere que as empresas nestes dois territórios, em teoria, necessitam de apoio financeiro, dado os níveis de PIB per capita abaixo da média em termos europeus. O papel dos fundos comunitários é relevante neste âmbito, na subsidiação do investimento privado, o que reforça o papel chave das autoridades regionais, de acordo com Niang et al. (2023). Os resultados obtidos neste estudo sugerem ainda que o setor da hotelaria está a desenvolver uma agenda própria, no sentido de acomodação da evolução ocorrida ao nível da indústria, ao inscrever a questão da EC nas suas estratégias empresariais.

Uma das vantagens dos territórios de pequena dimensão, como no caso da Grã-Canária e da RAM, reside na proximidade geográfica que oferece oportunidades acrescidas de colaboração e de identificação de sinergias (Paquin e Howard-Grenville, 2012; Beers et al., 2008), que devem

ser exploradas e incentivadas. Arsova et al. (2022) e Bacova et al. (2016) referem que as cidades e regiões são encaradas pelos especialistas como pioneiros na transição em direção à sustentabilidade, dado que podem iniciar medidas numa fase anterior à aplicação a nível nacional, sobretudo se a agenda EC constituir uma das prioridades da governação (CIRCTER, 2019).

Ainda sobre o papel dos governos regionais e locais. Embora a questão do apoio municipal não surja como relevante, numa ótica econométrica, a existência de limites em termos da capacidade de tratamento de lixos e resíduos impacta negativamente o ritmo de adoção. Mais, quanto maior a perceção sobre a existência de barreiras, menor o ritmo de adoção. Pelo que existe espaço para as autoridades locais procurarem convencer os empresários sobre a sua disponibilidade para resolver problemas em termos do escoamento dos resíduos e lixo. Dado o papel fundamental do grau de comprometimento a atitude pro-EC por parte dois diretores hoteleiros, compete aos governos locais e municípios atuar no sentido do reforço das atitudes positivas, por exemplo, através do lançamento de programas de apoio ao investimento e de redução da burocracia.

6-CONCLUSÕES

As taxas de adoção reportadas neste estudo mostram um padrão diferenciado por área, com valores relativos altos nos setores da água e energia e reciclagem. A área dos recursos humanos e RSC surge como a mais complexa, e com menor taxa de adoção. Os resultados sugerem que questões de custos não são relevantes, pelo que tal não impede ritmos de adoção elevados em áreas especificas, embora o impacto das barreiras seja relevante. A pressão dos clientes não parece relevante, mas os inquiridos declaram que a adoção da EC deriva de uma estratégia empresarial consistente nesta área, o que incluem preocupações com a imagem de marca, e o que deixa antever medidas pró-ativas de resposta a tendências consolidadas na área. Em termos dos fatores explicativos da taxa de adoção, a atitude e grau de comprometimento dos inquiridos é fundamental, tal como a importância da estratégia empresarial já deixava antever. Os limites externos relativos a problemáticas como a falta de contentores limita o número de adoções, assim como a dimensão da unidade hoteleira.

Os resultados reportados neste estudo sugerem que regiões e municípios podem desempenhar um papel chave na consciencialização, na monitorização e no apoio à difusão da EC através do fornecimento de equipamentos e soluções simples como contentores. Existe também espaço para apoiar a formação na área dos recursos humanos e RCS, onde se verifica pressão por parte dos clientes, o que potencia o interessa do setor empresarial.

Dado o papel que adoção de inovações genéricas tem na adoção a nível mais micro, importa facilitar o processo de desenvolvimento e apetrechamento das empresas na adoção de inovações. Embora os hotéis constituam das unidades empresariais com maior volume de recursos humanos, parecem existir carências em termos de colaboradores qualificados na área da inovação e EC. Outra área a privilegiar por parte dos governos regionais, é a componente de identificação de oportunidades e de mobilização de vontades.

A maior limitação deste estudo reside na dimensão da amostra. Malgrado os esforços, não foi possível abranger mais inquiridos. Contudo, como a amostra inclui os grupos hoteleiros mais representativos, os resultados obtidos sugerem indicações muito precisas sobre as tendências em curso, preferências e barreiras percecionadas, e sobre a evolução previsível em termos da adoção de medidas.

REFERÊNCIAS

Anand, S., Sen, A. (2000), Human development and economic sustainability, World Development, vol 28, nº 12, pg. 2029–2049. https://doi.org/10.1016/s0305-750x(00)00071-1.

Arbolino, R., Boffardi, R., Ioppolo, G., (2020), An insight into the Italian chemical sector: how to make it green and efficient. Journal Cleaner Production, vol 264, 121674 https://doi.org/ 10.1016/j.jclepro.2020.121674

Arnsperger, C., Bourg, D. (2016), Vers une économie authentiquement circulaire. Réflexions sur les fondements d'un indicateur de circularité, Revue de l'OFCE, vol 145, nº 1, pg. 91–125. doi :10.3917/reof. 145.0091

Arsova, S., Genovese, A., Ketikidis. P. (2022), Implementing circular economy in a regional context: A systematic literature review and a research agenda, Journal of Cleaner Production, vol 368, 133117

Assmann, D., Ehrl, P. (2021), Individualistic culture and entrepreneurial opportunities, Journal of Economic Behavior and Organization, vol 188, pg. 1248–1268

Bacová, M., Bohm, K., Guitton, M., Herwijnen, M., van Kallay, T., Koutsomarkou, J., Magazzù, I., O'Loughlin, E., Rok, A. (2016), Pathways to a Circular Economy in Cities and Region, Journal of Cleaner Production, vol 368, 133117, https://doi.org/10.1016/j.jclepro.2022.133117.

Bayon, D. (2007), Des économies vulnérables et dépendantes, Comprendre les économies d'outre-mer, L'Harmattan, 2007.

Beers, D., A. Bossilkov, G. Corder, Berkel., R. (2008), Industrial Symbiosis in the Australian Minerals Industry. The Cases of Kwinana and Gladstone, Journal of Industrial Ecology, vol. 11, nº 1, pg. 55–72, doi:10.1162/jiec.2007.1161

Bocken, N., Pauw, I., Bakker, C., van der Grinten, B. (2016), Product Design and Business Model Strategies for a Circular Economy, Journal of Industrial and Production Engineering, vol 33, nº 5, pg. 308–320.

Bolger, K., Doyon. A. (2019), Circular Cities: Exploring Local Government Strategies to Facilitate a Circular Economy, European Planning Studies, vol 27, nº11, pg. 2184–2205, doi:10.1080/ 09654313.2019.1642854

Cahoon, S., Pateman, H., Chen, S.-L. (2013), Regional port authorities: leading players in innovation networks?, Journal of Transport Geography, vol. 27, pg. 66–75

Candan, G., Toklu, M. (2022), A comparative analysis of the circular economy performances for European Union countries, International Journal of Sustainable Development & World Ecology, vol 29, nº 7, pg. 653-664, DOI: 10.1080/13504509.2022.2084794

Chidakel, A., Child, B., Muyengwa, S. (2021), Multiplier effects, and the enabling environment at South Luangwa National Park, Zambia, Ecological Economics, vol. 182, 106960

CIRCTER (2019), Circular economy and territorial consequences – policy guide. Available at: https://www.espon.eu/policy-guide-circular-economy.

Cother, G. (2020), Developing the circular economy in Tasmania, Action Learning: Research and Practice, vol 17, nº1, pg. 108-124, DOI: 10.1080/14767333.2020.1712850

Corsini, F., Bernardi, C., Frey, M. (2023), Industrial symbiosis as a business strategy for the circular economy: identifying regional firms' profiles and barriers to their adoption, Journal of Environmental Planning and Management, DOI: 10.1080/09640568.2022.2154201

Czarnitzki, D., Hottenrott, H. (2011), R &D investment and financing constraints of small and medium-sized firms. Small Business Economics, vol 36, pg. 65–83. https://doi.org/10.1007/ s11187-009-9189-3.

DesRoches, C. (2018), What is natural about natural capital during the anthropocene? Sustainability-Basel, vol. 10, nº 3, 806. https://doi.org/10.3390/su10030806.

Domenech, T., Bahn-Walkowiak, B. (2019), Transition towards a resource efficient circular economy in Europe: policy lessons from the EU and the member states, Ecological Economics, vol 155, pg 7-19.

Dong, L., H. Liang, L. Zhang, Z. Liu, Z. Gao, Hu. M. (2017), Highlighting Regional Eco-Industrial Development: Life Cycle Benefits of an Urban Industrial Symbiosis and Implications in China, Ecological Modelling, vol. 361, pg. 164–176. doi:10.1016/j.ecolmodel.2017. 07.032.

European Commission (2015), An EU Action Plan for the Circular Economy, Com 614:21. doi:10.1017/CBO9781107415324.004

European Commission (2019), Regional Innovation Scoreboard (RIS). doi:10.2873/89165

European Commission (2020), A New Circular Economy Action Plan for a Cleaner and More Competitive Europe, Official Journal of the European Union. https://eur-lex.europa.eu/legalcontent/ EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN

Florido, C.; Jacob, M., Payeras, M. (2019), How to Carry out the Transition towards a More Circular Tourist Activity in the Hotel Sector. The Role of Innovation, Administrative Science, vol. 9, pg. 47.

Geddes, A., Schmidt, T. (2020), Integrating finance into the multi-level perspective: Technology niche-finance regime interactions and financial policy interventions, Research Policy, vol. 49, nº 6, 103985. external pagehttps://doi.org/10.1016/j.respol.2020.103985call_made

Geisendorf, S., Pietrulla, F. (2018), The circular economy and circular economic concepts—a literature analysis and redefinition.,Thunderbird Int. Bus. Rev., vol. 60, nº 5, pg. 771–782

Geissdoerfer, M., Savaget, P., Bocken, N., Hultink, E. (2017), The circular economy – a new sustainability paradigm?, Journal of Cleaner Production, vol. 143, pg. 757–768. https://doi.org/10.1016/J.JCLEPRO.2016.12.048

Gemar, G., Soler, I., Moniche, L. (2023), Exploring the impacts of local development initiatives on tourism: A case study analysis, Heliyon, vol. 9, e19924

Ghisellini, P., Cialani, C., Ulgiati, S. (2016), A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems, Journal of Cleaner Production, vol 114, 11–32

Ghinoi, S., Silvestri, F., Steiner, B. (2020), The role of local stakeholders in disseminating knowledge for supporting the circular economy: a network analysis approach, Ecoogical Economics, vol. 169, 106446 https://doi.org/10.1016/j.ecolecon.2019.106446

Gonçalves, A., Galliano, D., Triboulet, P. (2021), Eco-innovations towards circular economy: evidence from cases studies of collective methanization in France, European Planning Studies, vol 30, nº7, pg. 1230-1250, DOI: 10.1080/09654313.2021.1902947

Gössling, T., Rutten, R. (2007), Innovation in Regions, European planning studies, vol. 15, nº 2, pg. 253-270 https://doi.org/10.1080/0965431060

Grafström, J., Aasma, S. (2021), Breaking circular economy barriers, Journal of Cleaner Production, vol 292, 126002.

Gravagnuolo, A., Angrisano, M., Girard, L.F. (2019), Circular economy strategies in eight historic port cities: criteria and indicators towards a circular city assessment framework, Sustainability, vol. 11, nº 13, https://doi.org/10.3390/su11133512.

Gura, K., Nica, E., Kliestik, T., Puime-Guillén, F. (2023), Circular economy in territorial planning strategy: Incorporation in cluster activities and economic zones, Environmental Technology & Innovation, vol. 32, 103357

Guerra-Rodríguez, S., Oulego, P., Rodríguez, E., Singh, D., Rodríguez-Chueca, J. (2020), Towards the implementation of circular economy in the wastewater sector: Challenges and opportunities, Water, vol 12, nº 5, http://dx.doi.org/10.3390/w12051431

Hadfield, P., Coenen, L. (2022), Contemporary financial capitalism and sustainability transitions in urban built environments, Environmental Innovation and Societal Transitions, vol. 42, pg. 285-300, https://doi.org/10.1016/j.eist.2022.01.004

Healey, P. (1997), Making strategic spatial plans innovation in Europe. London: UCL Press.

Henrysson, M., Nuur, C. (2021), The role of institutions in creating circular economy pathways for regional development, J. Environ. Dev., vol, 30, nº 2, pg. 149–171. https://doi.org/10.1177/1070496521991876

Heshmati, A., Rashidghalam, M. (2021), Assessment of the urban circular economy in Sweden, Journal of Cleaner Production, 310, 127475. http://dx.doi.org/10.1016/j.jclepro.2021.127475.

Högström, J., Balfors, B., Hammer, M. (2018), Planning for sustainability in expansive metropolitan regions: Exploring practice and planners' expectations in Stockholm, Sweden, European Planning Studies, vo. 26, nº 3, pg. 439–457, doi:10.1080/09654313.2017.1391751

IPCC (2014), Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Ismeri Europa (2009), Regional Challenges in the perspective of 2020, Regional disparities and future challenges, Synthesis report.

Ismeri (2011a), Growth Factors in the Outermost Regions, Final report - Vol. I ,

Ismeri (2011b), Growth Factors in the Outermost Regions, Final report - Vol. II,

Kirchherr, J., Piscicelli, L., Bour, R., Kostense-Smit, E., Muller, J., Huibrechtse- Truijens, A., Hekkert, M. (2018), Barriers to the circular economy: evidence from the European Union (EU). Ecological Economy, vol. 150, pg. 264–272. https://doi.org/10.1016/j. ecolecon.2018.04.028

Kirchherr, J., Reike, D., Hekkert, M. (2017), Conceptualizing the circular economy: an analysis of 114 definitions. Resource, Conservation and Recycling, vol. 127 https://doi.org/10.1016/j. resconrec.2017.09.005.

Kirchherr, J., Yang, N.-H-, Schulze-Spüntrup, F., Heerink, M., Hartley, K. (2023). Conceptualizing the Circular Economy (Revisited): An Analysis of 221 Definitions, Resources, Conservation & Recycling, vol. 194, 107001

Korhonen, J., Honkasalo, A. Jyri Seppälä, J. (2018), Circular Economy: The Concept and Its Limitations, Ecological Economics, vol. 143, pg. 37–46. doi:10.1016/j.ecolecon.2017.06.041

Kwok, A., Becker, J., Paton, D., Hudson-Doyle, E., Johnston, D. (2019), Stakeholders' perspectives of social capital in informing the development of neighborhood-based disaster resilience measurements, J. Applied Social Sciences, vol 13, nº 1, pg. 26–57. https://doi.org/ 10.1177/1936724419827987.

Lieder, M., Rashid, A. (2015), Towards circular economy implementation: a comprehensive review in context of manufacturing industry, Journal of Cleaner Production, col. 115, pg. 36-51

Lubowiecki-Vikuk, A., Dąbrowska, A., Machnik, A. (2021), Responsible consumer and lifestyle: Sustainability insights, Sustained Production Consumption, vol. 25, pg. 91-101. doi: 10.1016/j.spc.2020.08.007. Epub 2020 Aug 22. PMID: 32864405; PMCID: PMC7442902.

Majdak, P., Almeida, A. (2022), Managing pre-emptively overtourism by promoting rural tourism in low-density areas: lessons from Madeira, Sustainability, *14*, 757. https://doi.org/10.3390/su14020757

Masi, D., Day, S., Godsell, J. (2018), Supply chain configurations in the circular economy: a systematic literature review, Sustainability-Basel, vol. 9, nº 9, 1602. https://doi.org/ 10.3390/su9091602.

Meadows, D. (1998), Indicators and information systems for sustainable development. A report to the balaton group, Hartland: Hartland: the sustainability institute. Available at: http://donellameadows.org/wp-content/userfiles/IndicatorsInfo rmation.pdf.

Meili, R., Stucki, T. (2023), Money matters: The role of money as a regional and corporate financial resource for circular economy transition at firm-level, Research Policy, vol. 52, 104884

Menegaki, M., Damigos, D. (2018), A review on current situation and challenges of construction and demolition waste management, Current Opinion in Green and Sustainable Chemistry, vol. 13, pg. 8-15, https://doi.org/10.1016/j.cogsc.2018.02.010.

Mkono, M. (2020), Eco-hypocrisy and inauthenticity: Criticisms and confessions of the eco-conscious tourist/traveller, Annals of Tourism Research, vol 84, 102967, ISSN 0160-7383, https://doi.org/10.1016/j.annals.2020.102967.

Neves, A., Godina, R., Azevedo, S., Pimentel, C., Matias, J. (2019), The Potential of Industrial Symbiosis: Case Analysis and Main Drivers and Barriers to Its Implementation, Sustainability, vol. 11, nº 24, 7095. doi:10.3390/su11247095.

Niang, A., Bourdin. S,, Torre., A. (2023), The geography of circular economy: job creation, territorial embeddedness and local public policies, Journal of Environmental Planning and Management, DOI: 10.1080/09640568.2023.2210749

Olesen, K. (2013), The neoliberalisation of strategic spatial planning, Planning Theory, vol 13, nº 3, pg. 288– 303. doi:10.1177/1473095213499340

Opferkuch, K., Caeiro, S., Salomone, R., Ramos, T. (2021), Circular economy in corporate sustainability reporting: a review of organisational approaches, Bus. Strat. Environ., vol. 30, nº 8, pg. 4015–4036. https://doi.org/10.1002/bse.2854.

Papke, L., Wooldridge, J. (1996), Econometric methods for fractional response variables with an application to 401 (k) plan participation rates, Journal Applied Economics, Vol. 11, nº 6, pg. 619–632

Paquin, R., Howard-Grenville, J. (2012), The evolution of facilitated industrial symbiosis, Journal Industrial Ecology, 16 (1) (2012), pp. 83-93, 10.1111/j.1530-9290.2011.00437.xPascale, A., Vita, G., Giannetto, C., Ioppolo, G., Lanfranchi, M., Limosani, M., Katarzyna Szopik-

Depczy´nska, K. (2023), The circular economy implementation at the European Union level. Past, present and future, Journal of Cleaner Production, vol. 423, 138658

Poponi, S., Arcese, G., Mosconi, E.M., di Trifiletti, M. (2020), Entrepreneurial drivers for the development of the circular business model: the role of academic spin-off, Sustainability, vol. 12, nº 1, https://doi.org/10.3390/su12010423

Prendeville, S.,Cherim, E., Bocken, N. (2018), Circular Cities: Mapping Six Cities in Transition, Environmental Innovation and Societal Transitions, vol. 26, pg. 171–194. doi:10.1016/j.eist.2017.03.002

Ramalho, E., Ramalho, J., Murteira, J. (2011), Alternative estimating and testing empirical strategies for fractional regression models, Journal Economic Surveys, vol 25, nº , pg. 19–68

Refsgaard, K., Kull, M., Slätmo, E., Meijer. M. (2021), Bioeconomy – A driver for regional development in the Nordic countries, New BIOTECHNOLOGY, vol. 60, pg. 130–137

Reike, D., Vermeulen, W., Witjes, S. (2018), The circular economy: new or refurbished.as CE 3.0? d exploring controversies in the conceptualization of the circular economy through a focus on history and resource value retention options, Resources, Conservation and Recycling, vol. 135, 246-264.

Richter, R.. Christmann, G. (2021), On the role of key players in rural social innovation processes, EconStor Open Access Articles and Book Chapters, ZBW - Leibniz Information Centre for Economics, https://ideas.repec.org/a/zbw/espost/253375.html

Richter, J.L., Van Buskirk, R., Dalhammar, C., Bennich, P. (2018), Optimal durability in least life cycle cost methods: the case of LED lamps, Energ. Effic., vol. 12, pg. 107–121, https://doi.org/10.1007/s12053-018-9662-4.

Rodríguez, C., Florido, C., Jacob, M. (2020), Circular Economy Contributions to the Tourism Sector: A Critical Literature Review, Sustainability, vol. 12, 4338. https://doi.org/10.3390/su12114338

Rodríguez-Antón, J. M., e Alonso-Almeida, M. D. M. (2019). The circular economy strategy in hospitality: A multicase approach. Sustainability, 11(20), 5665

Rodríguez-Espíndola, O., Cuevas-Romo, A., Chowdhury, S., Díaz-Acevedo, N., Albores, P., Despoudi, S., Malesios, C., Prasanta P. (2022), The role of circular economy principles and sustainable-oriented innovation to enhance social, economic and environmental performance: Evidence from Mexican SMEs, International Journal of Production Economics, vol. 248, 108495, https://doi.org/10.1016/j.ijpe.2022.108495

Saarinen, A., Aarikka-Stenroos, L. (2022), Financing-related drivers and barriers for circular economy business: developing a conceptual model from a field study, Circ. Econ. Sust. pg. 1–25, https://doi.org/10.1007/S43615-022-00222-5.

Sacchi Homrich, A., Galvão, G., Abadia, L., Carvalho, M. (2018), The circular economy umbrella: trends and gaps on integrating pathways, Journal Cleaner Production, vol. 175, pg. 525-543

Sakai, S., Yoshida, H., Hirai, Y., Asari, M., Takigami, H., Takahashi, S., *et al.* (2011), International comparative study of 3R and waste management policy developments, J. Mater. Cycles Waste Manage., vol 13, nº 2, pg. 86–102. http://dx.doi.org/10.1007/s10163- 011-0009-x

Sánchez Levoso, A., Gasol, C., Martínez-Blanco, J., Durany, X, Lehmann, M., Gaya, R.F. (2020), Methodological framework for the implementation of circular economy in urban systems, Journal of Cleaner Production, vol, 248 https://doi.org/10.1016/j. jclepro.2019.119227.

Savini, F., (2023), Futures of the social metabolism: Degrowth, circular economy and the value of waste, Futures, vol. 150, 103180

Schmieder, L., Scheer, D., Gaiser, J., Jendritzki, I., Kraus, B. (2023), Municipalities as change agents? Reconsidering roles and policies in local energy sector-coupling, Energy Research & Social Science, vol. 103, 103210

Sharpley, R. (2003), Tourism, Modernisation and Development on the Island of Cyprus: Challenges and Policy Responses, Journal of Sustainable Tourism, Vol. 11, no. 2&3, pg. 246-265

Silvestri, F., Spigarelli, F., Tassinari, M. (2020), Regional development of circular economy in the European union: a multidimensional analysis, Journal of Cleaner Production, vol. 255, 120218, https://doi.org/10.1016/j.jclepro.2020.120218

Sorin, F., Sivarajah, U. (2021), Exploring Circular economy in the hospitality industry: empirical evidence from Scandinavian hotel operators, Scandinavian Journal of Hospitality and Tourism, vol. 21, nº 3, pg. 265-285, DOI: 10.1080/15022250.2021.1921021

Sörqvist, P., Langeborg, L. (2019), Why People Harm the Environment Although They Try to Treat It Well: An Evolutionary-Cognitive Perspective on Climate Compensation, Front. Psychol., vol 10, 348. doi: 10.3389/fpsyg.2019.00348

Spatial Foresight, SWECO, ÖIR, t33, Nordregio, Berman Group, Infyde (2017): Bioeconomy development in EU regions. Mapping of EU Member States'/regions' Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy for 2014-2020.

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M.Sörlin, S. (2015), Planetary boundaries: Guiding human development on a changing planet, Science, 347 (6223), 1259855. doi:10.1126/science.1259855

Vanhamäki, S., Virtanen, M., Luste, S., Manskinen, K. (2020), Transition towards a circular economy at a regional level: a case study on closing biological loops, Resources, Conservation and Recycling, vol 156, 104716 https://doi.org/10.1016/j. resconrec.2020.104716.

Velenturf, A., Purnell, P. (2021), Principles for a Sustainable Circular Economy, Sustainable Production and Consumption, vol. 27, pg. 1437–1457. doi:10.1016/j.spc.2021.02.018

Veyssière, S., Laperche, B., Blanquart, C. (2022), Territorial development process based on the circular economy: a systematic literature review, Eur. Plan. Stud., vol 30, pg. 1192–1211. https://doi.org/10.1080/09654313.2021.1873917.

Yang, M., Smart, P., Kumar, M., Jolly, M., Evans, S. (2018), Product-service systems business models for circular supply chains. Prod. Plann. Contr. 29 (6), 498e508. https://doi.org/10.1080/09537287.2018.1449247.

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Effect Of Financial Development on Economic Growth in Developed and Developing Economies: Is the Measurement of Financial Development Relevant?

Efecto del Desarrollo Financiero en el Crecimiento Económico en las Economías Desarrolladas y en Desarrollo: ¿Es Relevante la Medición del Desarrollo Financiero?

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Abstract

Financial institutions, together with stock markets, actively promote financial development in economies worldwide, which has significantly boosted the economic growth of some countries. By applying cointegration techniques, this study analyzes the long-term relevance between economic growth, financial development, human capital, globalization and primary energy use for a sample of 76 countries during the period from 1980 – 2019. Understanding the possible differences between developed and developing countries, this study shows that financial development in terms of banking institutions contributes significantly to the growth of developing economies, while financial development more oriented to stock markets contributes significantly to the growth of developed economies. The role of human capital is crucial in economic growth, both in developed and developing economies in the long term. On the other hand, globalization in political terms only affects developing economies, which, unlike developed economies, have a lower presence in the rest of countries. Finally, both developing and developed economies still base their growth on the use of primary energy.

Keywords: economic growth; financial development; developed countries; developing countries; panel data; cointegration.

JEL codes: O16, O40, E44.

Resumen

Las instituciones financieras, junto con los mercados de valores, promueven activamente el desarrollo financiero en las economías de todo el mundo, lo que ha impulsado significativamente el crecimiento económico de algunos países. Aplicando técnicas de cointegración, este estudio analiza la relevancia a largo plazo entre el crecimiento económico, el desarrollo financiero, el capital humano, la globalización y el uso de energía primaria para una muestra de 76 países durante el período de 1980 a 2019. Entendiendo las posibles diferencias entre países desarrollados y en desarrollo, este estudio muestra que el desarrollo financiero en términos de instituciones bancarias contribuye significativamente al crecimiento de las economías en desarrollo, mientras que el desarrollo financiero más orientado a los mercados de valores contribuye significativamente al crecimiento de las economías desarrolladas. El papel del capital humano es crucial en el crecimiento económico, tanto en las economías desarrolladas como en las que están en desarrollo en el largo plazo. Por otro lado, la globalización en términos políticos solo afecta a las economías en desarrollo, que, a diferencia de las economías desarrolladas, tienen una menor presencia en el resto de países. Finalmente, tanto las economías en desarrollo como las desarrolladas aún basan su crecimiento en el uso de energía primaria.

Palabras clave: crecimiento económico; desarrollo financiero; países desarrollados; países en desarrollo; datos de panel; cointegración.

Códigos JEL: O16, O40, E44.

1. INTRODUCTION

Nowadays, the impact of financial markets on economies around the world is indisputable. However, the crucial point that arises in the discussion of this topic generally revolves around establishing whether this impact is positive or negative for the economic growth processes of countries. On the one hand, and as mentioned by authors such as McKinnon and Shaw (1973), referents in the analysis of the effects of financial liberalization on economic growth, financial markets or systems contribute to the increase in the level of savings and investment and therefore, they positively affect the level of economic activity of countries. Likewise, authors such as Schumpeter (2017) argue that financial systems are fundamental for generating technological innovations, making it possible for economies with more efficient financial systems to grow faster than those that do not have such conditions.

On the other hand, in the Schumpeterian line of thought, King and Levine (1993) proposed an endogenous growth model, where the close relationship between finance and entrepreneurship is key not only to produce innovations, but also to manage business investment activities better, improving efficiency and productivity and generating sustainable growth processes. However, there are also opposing views, such as the one by Minsky (1978, 1992), who mentioned that capitalist market mechanisms do not guarantee a sustained equilibrium with stable prices and full employment in the markets for goods and services and in financial markets. There is a "financial fragility" inherent to the natural behavior of the maximizing agents of the economy, which can negatively affect investment and economic growth processes, due to the high levels of indebtedness and financial deregulation that usually precede events such as the "Great Depression" of 1932 and the real estate and financial crisis of 2008-2009 (Carvajal, 2015).

On the other hand, and as shown in the previous paragraph, the heterogeneity of financial markets is one of the main causes of uneven economic growth between developed and developing countries. Thus, for example, according to data from the International Monetary Fund (2020), on average, the financial development of developed countries represents approximately 2.43 times the development of the sector in developing countries, during the period 1980-2015; Something similar occurs with per capita income, whose average value is approximately 9.27 times higher in developing countries than in developing countries, during the same period.

Taking into account these data and the interest in establishing the effects of the development of financial markets on economic growth, the objective of this research is to estimate the long-term

relationship between economic growth and some relevant explanatory variables such as financial development, human capital, globalization and the use of primary energy. As a research hypothesis, it is considered that financial development contributes mostly to the growth of developed countries and to a lesser extent to that of developing countries. For this reason, using information on GDP per capita as a dependent variable; the Financial Development Index (FD), a proxy variable for financial development; the Financial Institutions Index (FI), which represents the importance of financial institutions in economies and; the Financial Markets Index (FM), which includes the impact of the stock market, as the main explanatory variables; and the control variables: Human Capital; the Political Globalization (PGL) index, which represents the dissemination of government policies and; Primary Energy use (PE), as control variables, a cointegration process is estimated for a panel of 81 countries worldwide, classified into developed countries and developing countries, during the period 1980-2015.

Among the main results found, the existence of cross-sectional dependence in the residuals of the main regression is evident, which suggests the use of statistical tests that consider such correlation; thus, by means of the CIPS unit root test, it was found that all variables must be differentiated once to become stationary series. Then, the Slope Homogeneity Test of Pesaran and Yamagata (2008) was applied, which provides statistical evidence to reject the null hypothesis of slope homogeneity, corroborating the results of the Pesaran cross-sectional dependence test (2007).

Continuing with the process, the Westerlund (2007) cointegration test was estimated, confirming the existence of long-term equilibrium between the model variables. Subsequently, using the FMOLS and DOLS estimators, a positive and statistically significant effect of financial development and the presence of financial markets on the economic growth of developed countries was identified, unlike what occurred with developing countries, where only the impact of financial institutions generates a statistically positive effect. Finally, through the causality test of Dumitrescu and Hurlin (2012), a relationship was obtained that goes from the FD, FI and FM indices to the GDP for developing countries and a relationship that goes from GDP to the FD and FI indices, in the case of developed countries. One of the main corollaries of the aforementioned results is that developing countries should implement economic policies aimed at boosting and developing their financial markets, mainly their stock markets, and their level of human capital, in order to generate a significant impact on their long-term growth processes.

It is important to highlight that unlike the literature that studies the effect of financial development on economic growth (Calderón & Liu, 2003; Khan & Senhadij, 2003; Abu-Bader & Abu-Qarn, 2008; Hassan et al., 2011; Valickova et al., 2015; Ibrahim & Alagidede, 2018; Cao et al., 2022; Kirikkaleli et al., 2022; Shahbaz et al., 2022; Hodijah & Hastuti, 2023), this research provides empirical evidence on the long-term relationship between these variables, using panel data and including some characteristics of developed and developing countries, which explain the disparate effects on economic growth between these two groups of countries. Furthermore, the study fills the gap regarding the specification of financial development. This is considered both from the market and institutional components, which boosts the differentiation of the type of financial development that promotes growth in developed and developing economies.

The structure of the work after the introductory section is as follows: the second section presents the Literature Review, where empirical evidence documents that study this research topic are analyzed. The third section includes an Empirical Analysis, which includes the subsections of Data, Model Specification and Econometric Strategy. The fourth section presents the empirical results and their discussion and the fifth section highlights the main conclusions and policy recommendations regarding the topic studied.

2. LITERATURE REVIEW

In the study of the link between financial development and economic growth, empirical evidence suggests a broad debate without a defined consensus. From a theoretical point of view, authors such as Schumpeter (2017) and Goldsmith (1969) consider that the financial system has a direct relationship with growth and that it plays a crucial role in promoting it. Meanwhile, Robinson (1952) proposes the existence of an inverse relationship between the financial system and economic

activity. Similarly, from the empirical point of view, the literature shows different contributions for and against the relevance of the financial system.

In terms of empirical evidence that validates an inverse relationship between the variables, works such as those by Tinoco, Torres, & Venegas (2008) stand out, which examine for Mexico the long-term effect of financial regulation on economic growth, and financial intermediation on productive activity, and through a cointegration model and a causality analysis they find that neither financial development nor regulation affect the dynamics of GDP; however, they verify that regulation has a negative effect on financial development.

Along the same lines, Ductor & Grechyna (2013), in a study for 33 OECD countries, found that if the financial sector is not accompanied by growth in the real sector, the effect of financial development on economic growth becomes negative in the long term. Adeniyi et al. (2015) and Diallo (2017) also validated these results and suggest that financial development negatively affects growth. Ahmed, Hossain, & Tareque (2020) even suggest that in both the short and long term, financial development has a negative impact on growth. The authors' analysis considered Bangladesh as a case study using an autoregressive model with distributed delays (ARDL) as a methodology.

In contrast to these findings, there is also evidence in favor of the positive impact of financial development on a country's economic growth. Da Silva, et al (2017); Ibrahim, & Alagidede (2018); Mallick et al (2018); Ibrahima & Alagidede (2018); Kadozi (2019); Botev et al (2019) and Chu & Chu (2020) highlight that financial development is positively and significantly associated with economic growth. Some even highlight that this positive effect is mainly related to the institutional quality of case studies, considering that strong institutions facilitate the implementation of the functions of the financial sector in the efficient allocation of resources. Evidence suggests that weak institutions and poor government regulation can reduce productivity (Assefa & Mollick, 2017). Aluko & Ibrahim (2020), for example, in a study for 28 sub-Saharan African countries, by using threshold regressions, found that financing is positively associated with growth for countries with institutional quality above a particular threshold.

On the other hand, the presence of the stock market in the analysis also tends to be another determining factor of the impact of financial development on growth. Chu (2019) points out that in order to accelerate the growth of an economy, the financial system must be more market-based, in terms of activity and efficiency. Furthermore, in Botev et al (2019), they reveal that the positive effect of bank financing is greater in the presence of deeper capital markets and emphasize that finance has a stronger positive effect in more developed countries. In fact, in research that classifies the sample according to income level, such as the work of Berhane (2018), it is shown that financial development has a positive effect on economic growth in all countries, but in upper middle-income countries, the regressors are insignificant.

Similarly, a study for 168 countries classified by geographic region and income level shows that there is a positive association between finance and economic growth for developing countries, but the results are contradictory for high-income countries. Furthermore, it is pointed out that in developing countries, proper functioning of a financial system is a necessary, but not a sufficient condition to achieve sustained economic growth, since, in the real sector, trade and public spending play a crucial role (Hassana, Sanchez, & Yu, 2011).

In addition, it is also interesting to observe that the relationship between growth and financial development usually has a positive or negative effect depending on the indicator used to represent the latter. In particular, Adu, Marbuah, & Mensah (2013), in their research for Ghana, mention that when using private sector credit in relation to total credit, there is a positive and statistically significant effect of financial development on growth. However, this result changes when money supply is used as a proxy for financial development. In this case, the coefficient remains significant, but is now negative. On the other hand, in Adeniyi et al. (2015), a composite index of financial development is used, which considers the relationship between liquid liabilities and GDP and domestic credit to the private sector as a percentage of production, and verify that financial development negatively affected growth.

The literature clearly reveals a wide variety of studies in the analysis of the relationship between financial development and growth, typically evaluating the effect and causality between the variables, using mostly time series, and few studies, panel data with a classification of countries. Finally, it is still not clear whether the development of the financial sector contributes to economic

growth or not, and furthermore, the critical functions of the development stages of economies and the differences they comprise in relation to financial development have not been studied. In this regard, in this paper this gap in the literature is addressed by analyzing how financial development affects countries differently depending on the level of development, by using panel-type data cointegration as a methodology for the period 1980-2015.

3. EMPIRICAL ANALYSIS

3.1. Data

The selection of the sample and the study period was based on the availability of information for the 76 countries worldwide in the period from 1980 – 2019 (see Appendix 1). The entire sample is divided into two groups: developed and developing countries; these two groups make up the income classification by the World Bank Atlas method (2019), which is based on the gross national income per capita (GNI) of each country, since our interest focuses on examining the critical functions of the development stages of countries and the differences they comprise in relation to financial development. The group of developed countries considers 33 High-Income Countries (HICs) (US $12,695 or more), while the group of developing countries is made up of 43 upper-middle-income countries (UMICs) (US $4,096 – 12,695) and lower-middle income countries (LMICs) (US $1,046 – 4,095).

Likewise, Table 1 presents the variables used: GDP per capita (at constant 2015 prices) (GDP) is considered the dependent variable, which represents the economic growth of each economy under study. Furthermore, the use of this measure as a measure of economic growth has several advantages, such as its ability to offer a common and standardized metric (Song et al., 2021). As well as quantifying the total value of goods and services produced in an economy during a given period (Cuesta-Valiño et al., 2024; Gutiérrez-Rodríguez et al., 2024). Secondly, the independent variables that represent financial development were taken from the data presented by the International Monetary Fund (2020), which are the Financial Development Index (FD), representing the final financial development of an economy, the Financial Institutions Index (FI), which represents the level of presence of banking institutions in each economy and Financial Markets, which shows information more related to the presence of the stock market. According to the index calculation methodology (Svirydzenka, 2016), the measures that make up the final version of the index can be used, since the calculation of dimensions consists of (i) a normalization of the variables; (ii) aggregation of the normalized variables in the sub-indexes that represent a specific functional dimension; and (iii) aggregation of the sub-indexes in the final index.

On the other hand, as control variables, we considered Human Capital (HC), which represents the average educational level of the population of an economy. This was extracted from the Penn World Table version 10.0 (2020); the Political Globalization (PGL) index, which represents the institutionality, considering characteristics of policy diffusion with other economies, which was taken from the KOF Swiss Economic Institute (2020). Finally, the use of Primary Energy (PE) plays an important role in the long-term development of economies, influencing the sustainability of resources and their economic development (see Table 1).

Table 1. Descriptive statistics of the variables and statistical resources

Variable type	Variable name	Symbols	Variable definitions (measurement)	Source
Explained variable (Dependent variable)	*Economic Growth*	GDP	It is the gross domestic product divided by the population at mid-year, expressed in 2010 dollars.	WDI (2022)
Explanatory variable (Independent variable)	*Financial Development*	FD	Relative ranking of countries on the depth, access and efficiency of their financial institutions and financial markets.	IMF (2022)
	Financial Institutions	FI	It includes banks, insurance companies, mutual funds, pension funds, and other types of non-bank financial institutions.	IMF (2022)
	Financial Markets	FM	It includes mainly stock and bond markets.	IMF (2022)
Control variables	*Human Capital*	HC	It consists of the value given to the professional skills that an individual has, based on accumulated knowledge and experiences.	PWT 10.0 (2022)
	Political globalization	PGL	It includes features of government policy dissemination such as: Embassies, international organizations, international treaties, international NGOs among others.	KOF (2022)
	Energy	PE	It refers to use of primary energy before transformation to other end-use fuels.	WDI (2022)

Table 2 reports the descriptive statistics of each of the variables used in this research. The variables form an exactly balanced panel in both subgroups, with 1296 and 1620 observations respectively, for 36 years (T=1, 2, …,36) and 81 countries (i=1, 2, …,81). Real production per capita is taken as a measure that captures economic growth, while capturing changes in the total population, as it is a measure in per capita terms (Adu et al., 2013; Ben Jedidia et al., 2014; Durusu-Ciftci et al., 2017). By using the Financial Development Index, which represents the financial development of the country, authors such as Ibrahim and Alagidede (2018) and Zhang et al. (2012) consider that this indicator provides information on the interaction that the financial sector has on the economy, more specifically on the financial credit market, which generates the creation or increase of the productive system.

Similarly, it can be seen that on average, the income of developed countries ($32,900.82) is higher than that of developing countries ($3,550.53). In addition, this difference occurs in financial development, with an average of 0.531 in developed countries compared to developing countries that reach 0.227. This same difference occurs when considering financial institutions and stock markets, within the subcategories of financial development indicators. Similarly, the rest of the variables show significant differences between the two subsamples considered for the analysis. For subsequent estimations, the natural logarithms of all the variables were considered, with the objective of measuring elasticities with respect to economic growth.

In relation to the normality tests, in both groups of countries, many variables have Skewness values close to 0, indicating symmetry in the distributions. Likewise, Kurtosis is less than 3 in many variables, indicating normal tails and the low existence of extreme values. Finally, in most of the variables, the Jarque-Bera test rejects the hypothesis of normality (given the significance value ***), which suggests that the distributions are normal.

Table 2. Descriptive statistics

Variables		Mean	Std. Dev.	Min.	Max.	Skewness	Kurtosis	Jarque-Bera
Developed countries								
GDP		36213.34	19534.99	2271.35	112417.9	1.172	4.995	533.03***
FD		0.538	0.210	0.010	1.000	0.008	2.142	42.920***
FI		0.619	0.200	0.010	1.000	-0.316	2.087	71.968***
FM		0.440	0.255	0.010	1.000	0.228	1.929	79.168***
HC		2.931	0.489	1.617	4.352	-0.367	2.488	46.722***
PGL		76.328	18.182	21.034	98.144	-0.768	2.586	147.58***
PE		4531.34	2978.66	414.62	18178.14	1.507	6.206	1129.52***
Developing countries								
GDP		3444.37	2716.32	181.18	14200.27	1.311	4.411	606.55***
FD		0.221	0.135	0.010	0.739	1.233	4.197	513.45***
FI		0.277	0.119	0.010	0.721	1.152	4.375	492.30***
FM		0.159	0.181	0.010	0.735	1.119	3.216	345.97***
HC		2.003	0.470	1.088	3.097	0.115	2.069	62.816***
PGL		66.260	14.702	21.781	92.585	-0.378	2.703	45.222***
PE		787.80	548.58	104.86	3515.13	1.936	7.294	2285.68***

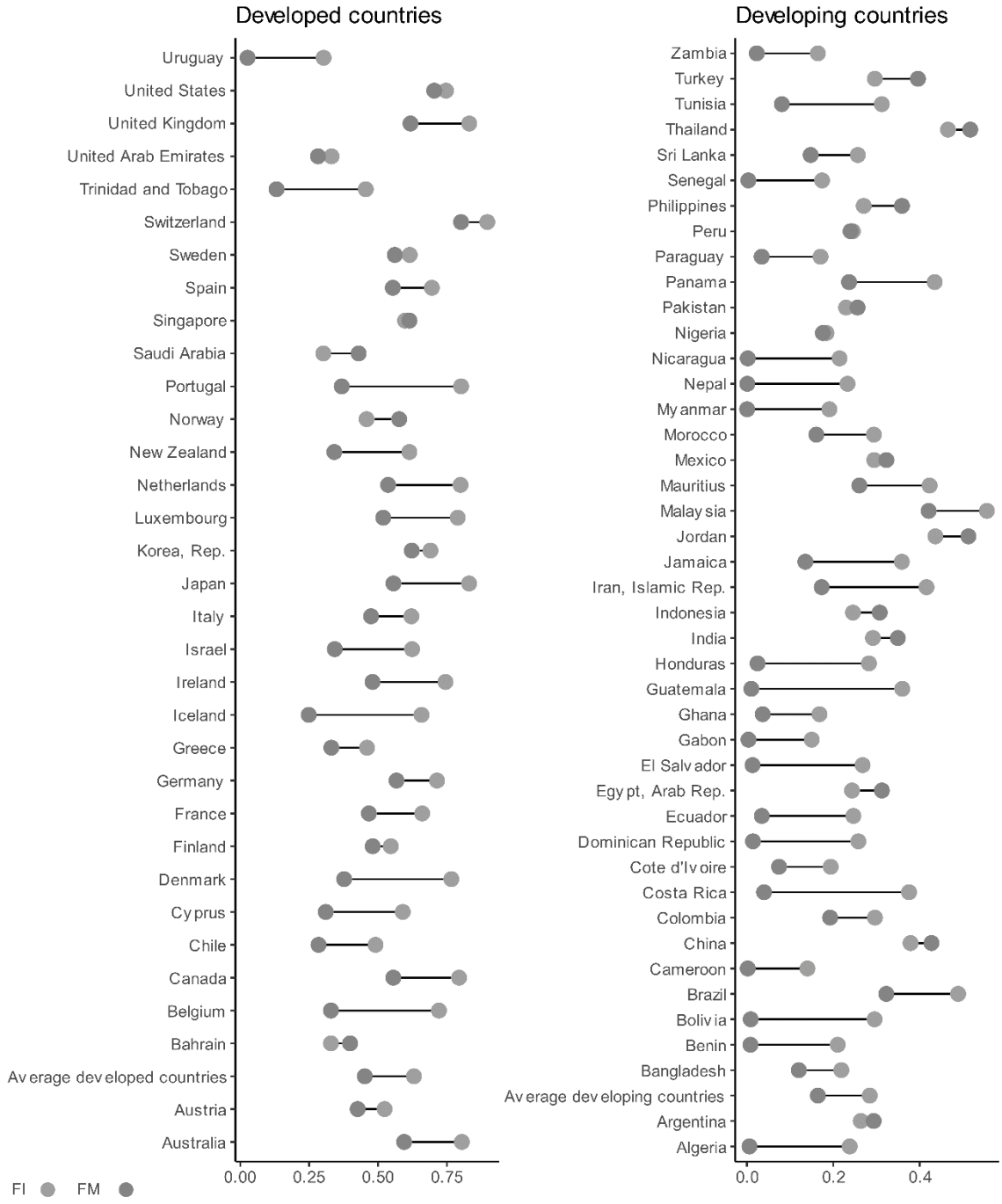
Figure 1 shows the spatial distribution of the 81 study countries divided into two subsamples, developed and developing economies for the three measures of financial, institutional and market development. It can be seen that economies such as the United States, Australia and most of Europe have high levels of financial development in the three study categories, while developing economies located in Latin America tend to show financial development with a trend towards the high presence of banking institutions, as in the case of Brazil. On the other hand, the development of the stock market is highly related to developed economies with high per capita growth, which is the case of the United States, Japan and the United Kingdom, countries where the development of these markets has a high presence and is linked to the growth of these economies.

Fig.1. Spatial distribution of study indicators at the global level

Notes: the arithmetic mean (1980 to 2015) of FM and FI is used.

Likewise, Figure 2 shows the differences in the means related to the financial variables FI and FM, in both subsamples and by country. It can be seen that FI is more significant in both subsamples, related to the development of banking institutions. These differences would show the level of development of this sector on the economies and the most significant impact on the economic growth of each subsample. As shown, there are few economies that maintain equal indices, both in FI and FM. However, it is evident to observe that in the sample of developed economies, unlike those in development, there is a higher average of FM linked to a greater presence of stock markets in these economies, so it is evident that the financial structure varies between the study subsamples.

Fig.2. Average financial indicators by country



Notes: the arithmetic mean (1980 to 2015) of FM and FI is used.

3.2. Model Specification

This study analyzes the relationship between economic growth and financial development worldwide, considering two analysis subsamples, evaluating the long-term relationships between these variables, taking into account institutionality and human capital, estimated from the following equation:

$$\ln(GDP)_{i,t} = \varphi_0 + \varphi_1 \ln FD_{i,t} + \varphi_2 \ln HC_{i,t} + \varphi_3 \ln PGL_{i,t} + \varphi_4 \ln PE_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where $\log(GDP)_{i,t}$ represents the logarithm of per capita production for country i in period t, $\ln FD_{i,t}$ represents financial development, $\ln HC_{i,t}$ human capital, $\ln PGL_{i,t}$ political globalization and $\ln PE_{i,t}$, the country's primary energy consumption i in period t. This last one is limited by the information available. Finally, $\varepsilon_{i,t}$ represents the error term; the results obtained at this stage are of interest because they indicate the sign and size of the effect of the independent variables on the dependent variable. The parameter $\ln FD_{i,t}$ is replaced by FI and FM for the analyses of each of these indicators in the estimates for each subsample.

Specifically, the methodology starts with the estimation of the cross-sectional dependence test of Pesaran (2007), in order to establish the relevance of the use of statistical tests that consider the correlation of the error between the cross-sections; then the Im, Pesaran and Shin unit root test of augmented cross section (CIPS) is applied, seeking to determine the stationarity of the series used; subsequently, the Westerlund (2007) cointegration test, the fully modified OLS estimators (FMOLS) and the dynamic OLS estimator (DOLS) are estimated, with the objective of finding the long-term relationship between the analyzed variables; finally, the causality test for panel data by Dumitrescu and Hurlin (2012) is carried out to establish, for example, if causality goes from financial development to economic growth, as suggested by Schumpeter (2017) and Goldsmith (1969), or if on the contrary, it goes from economic growth to financial development, as indicated by authors such as Robinson (1952).

3.3. Econometric Strategy

Pesaran (2004) and (2007) point out that panel data are likely to show considerable cross-sectional dependence in the error terms, due to unobserved and common shock factors. The effect of cross-sectional dependence is estimated variably and is based on common unobserved factors such as the nature of cross-sectional dependence, as well as the magnitude of correlations between cross-sections. The common effect of cross-sectional dependence gives rise to standard errors, causing biases in the estimation, whereas fixed effects (FE) and random effects (RE), although they are not efficient, they have consistent estimators. To deal with this problem, the use of the approach, which is proposed by Driscoll & Kraay (1998), may not work, and the FE and RE estimators would be biased. Another method is to use the instrumental variables (IVs) approach. However, finding IVs in practice is not easy. In equation (1) above, T denotes the temporal dimension of the panel, N denotes the cross-sectional dimension, and uit denotes the "error term". The hypotheses are:

$H_0: p_{ij} = p_{ij} = cor(u_{it}, u_{jt}) = 0$ for $i \neq j$

$H_a: p_{ij} = p_{ij} \neq 0$ for some $i \neq j$

where p_{ij} is the pairwise correlation coefficient of the error term:

$$p_{ij} = p_{ji} \frac{\sum_{t=2}^{T} u_{it} u_{jt}}{\left(\sum_{t=1}^{T} u_{it}^2\right)^{\frac{1}{2}} \left(\sum_{t=1}^{T} u_{jt}^2\right)^{\frac{1}{2}}} \quad (2)$$

With the test of Pesaran (2004) and (2007), Pesaran developed the following CD statistic, which is based on the LM statistic of Breusch & Pagan (1980):

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) \quad (3)$$

This CD statistic is better than the LM statistic because the exact mean for the fixed numbers T and N includes heterogeneous/homogeneous and non-stationary models.

3.3.1. Unit Root Test

Pesaran (2007) introduced a panel unit root test using augmented Dickey-Fuller regression (ADF) with the cross-sectional averages of the lagged level variable and the first difference operator

of the individual series. With N cross section of countries and T time period, this study uses the heterogeneous linear dynamic model, following Pesaran (2007) and is written as:

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \gamma \bar{y}_{t-1} + \delta_i \Delta \bar{y}_t + \varepsilon_{it} \tag{4}$$

Where $y_{t-1} = \frac{1}{N}\sum_{i=1}^{N} I_{it-1}$ and $\Delta\bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} y_{it}$, the mean of the cross section of the lagged levels I_{t-1} and of the first difference $\Delta\bar{I}_t$ of each series indicates the the cross section dependence through a factorial structure. Pesaran (2007) obtains the modified IPS statistics from the average of the cross-sectional augmented individual Dickey-Fuller distribution (CADF) presented as a cross-sectional augmented IPS (CIPS). The CIPS for the ith cross-sectional unit is given as follows:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \tag{5}$$

3.3.2. Cointegration Test

This study identifies the cointegration between income inequality, economic development and economic development squared, for different groups of countries according to income level. The null hypothesis of no cointegration versus cointegration between the variables is considered. Therefore, the cointegration test introduced by Westerlund (2007) is used for the panel data. This considers structural dynamics rather than residual dynamics; therefore, we do not place any restrictions on any common factors. Furthermore, Westerlund's (2007) error correction model assumes that all variables are integrated in order 1 or I (1) and is written as follows:

$$\Delta x_{it} = \theta_i d_i + \pi_i(x_{it-1} - \grave{\beta_i} y_{it-1}) + \sum_{j=1}^{m} \pi_{ij}\Delta x_{it-j} + \sum_{j=1}^{m} \varphi_{ij}\Delta y_{it-j} + \varepsilon_{it} \tag{6}$$

Where $d_t = (1-t)\grave{}$ contains the deterministic components and $\grave{\theta} = (\theta_{1i}, \theta_{2i})\grave{}$ is the vector of unknown coefficients to estimate. The error correction coefficient π_i is estimated using the ordinary least squares method. The above equation can be written as:

$$\Delta x_{it} = \theta_i d_i + \pi_i(x_{it-1} - \grave{\tau_i} y_{it-1}) + \sum_{j=1}^{m} \pi_{ij}\Delta x_{it-j} + \sum_{j=1}^{m} \varphi_{ij}\Delta y_{it-j} + \varepsilon_{it} \tag{7}$$

Where π_i indicates the speed of adjustment to adjust the system back to equilibrium. The previous equation confirms that the coefficient π_i is not affected by imposing an arbitrary $\grave{\tau_i}$. We apply the test in the least squares estimator π_i and we calculate the t-ratio for each cross-section of countries. These are known as group mean statistics and are written as:

$$G_1 = \frac{1}{N}\sum_{i=1}^{N} \frac{\pi_i}{S.E(\hat{\pi}_i)} \qquad \text{And} \qquad G_2 = \frac{1}{N}\sum_{i=1}^{N} \frac{T\pi_i}{\hat{\pi}_i(1)}$$

G1 and G2 test the null hypothesis that $H_0: \pi_i = 0$ for all i against $H_1: \pi_i < 0$ for some i. If the null hypothesis is rejected, then it shows the cointegration relationship of at least one cross-sectional unit. The other two test statistics are presented as:

$$P_1 = \frac{\hat{\pi}_i}{S.E(\hat{\pi}_i)} \qquad \text{And} \qquad P_2 = T\hat{\pi}_i$$

P1 and P2 test the null hypothesis that $H_0: \pi_i = 0$ for all i against $H_1: \pi_i < 0$ for some i. Rejection of the null hypothesis implies rejection of a non-cointegration relationship for the panel of countries as a whole. If there is a cointegration relationship between variables, then this study uses the panel technique to estimate the long-run and short-run coefficients.

3.3.3. Long-Term Estimates

Once a cointegration relationship has been determined between the variables of the empirical model, we are practically interested in estimating the consistent parameters of the variables discussed in the empirical model.

However, according to Behera & Dash (2017), the use of the standard ordinary least squares (OLS) technique on non-stationary panel data may lead to false inferences in the estimation equation. Therefore, to avoid the type of inconsistency with respect to the OLS method, it is necessary to apply the fully modified OLS estimator (FMOLS) proposed by Pedroni (2001) and the dynamic OLS estimator (DOLS) proposed by Stock & Watson (1993). FMOLS is believed to eliminate the problem of endogeneity in the regressors and serial correlation in the errors, which can lead to a consistent estimation of parameters in a relatively small sample. Similarly, the DOLS estimator solves the problem of endogeneity, multicollinearity, and serial correlation by including the leads and lags of the I (1) regressors in the regression. This paper uses the Pedroni (2004) model:

$$Y_{it} = \alpha_i + \beta_i EC_{it} + \mu_{it}; i = 1,2, \dots, N \text{ and } t = 1,2, \dots, T$$

Where Y_{it} denotes the dependent variable and EC denotes the residual and different stationarity vector.

$$Y_{it} = \alpha_i + \beta_i EC_{it} + \sum_{k=-k_j}^{k_i} \gamma_{ik} \Delta EC_{it-k} + \mu_{it}; i = 1,2, \dots, N$$

Below are the FMOLS and DOLS estimators:

$$\beta^*_{fmols} = N^{-1} \sum_{1}^{N} \left(\sum_{t=1}^{T} (EC_{it} - \overline{EC_\iota})^2 \right)^{-1} \left(\sum_{t=1}^{T} (EC_{it} - \overline{EC_\iota})\, y^*_{it} - T_{\hat{\gamma}_\iota} \right) \tag{8}$$

$$\beta^*_{dols} = N^{-1} \sum_{t=1}^{N} \left(\sum_{t=1}^{T} z_{it}\, z^i_{it} \right)^{-1} \left(\sum_{t=1}^{T} z_{it}\, Y^*_{it} \right) \tag{9}$$

Where Z_{it} is the $2(K+1) \times 1$ vector of regressors.

$$Z_{it} = \left\{ \left(X_{i,t} - \overline{X_\iota} \right), \Delta X_{i,t-k}, \dots, \Delta X_{i,t+k} \right\}; \tilde{Y}_{i,t} = Y_{i,t} - \overline{Y_\iota}$$

3.3.4. Causality Test

The existence of a cointegration relationship suggests that there is a long-term equilibrium between the variables, so we proceed to examine the causal relationship between these variables. In this study, the Dumitrescu and Hurlin (2012) panel causality test was chosen, since it has good properties in small samples, in addition to being able to integrate cross-sectional dependence in its analysis. The Dumitrescu and Hurlin (2012) test considers the following model:

$$Y_{i,t} = \varphi_i + \sum_{k=1}^{k} \gamma_i^{(k)} Y_{i,t-k} + \sum_{k=1}^{k} \theta_i^{(k)} X_{i,t-k} + \varepsilon_{it} \tag{10}$$

Where $K \in N^*$ and $\theta_i = \left(\theta_i^{(1)}, \dots, \theta_i^{(k)} \right)$. The null hypothesis is defined as $H_0: \theta_i = 0, \forall\, i = 1, 2 \dots N$ and the alternative hypothesis is defined as $H_1: \theta_i = 0, \forall\, i = 1, 2 \dots N_1$ and $\theta_i \neq 0, \forall\, i = N_1 + 1, N_1 + 1, \dots, N$. Specifically, the null hypothesis states that there is no homogeneous Granger

causality in the panel, while the alternative hypothesis states that at least one causality can be found in the panel.

4. EMPIRICAL RESULTS

Recent empirical evidence (Mercan et. al (2015); Ho (2015); Månsson & Sjölander (2014); Solberger (2011)) points out the importance of considering cross-sectional dependence (CD) in panel data estimates, with the objective of not generating biased coefficients (Pesaran, 2004). The results shown in Table 4 reject the null hypothesis of independence of CD at 1%, thus highlighting the importance of integrating CD among the sample of study countries. The test on the global sample is estimated, since regional proximity does not apply to the economic structure of the countries, but to their level of economic growth.

Table 4. Cross-sectional dependence tests

Variables	lnGDP	lnFD	lnFI	lnFM	lnHC	lnPGL	lnPE
CD-test	228.424***	173.21***	144.13***	137.30***	321.86***	283.84***	106.11***

Notes: The CD-test performs the null hypothesis of cross-sectional independence. The test statistic follows the normal standard distribution N (0, 1). *** denotes significant at the 1% level.

In the second stage of the analysis, the CIPS unit root test was applied, which is the same test that integrates the CD, generating accurate results. The results of this test are shown in Table 5. They show that after the first differentiation, all the variables are stationary at 1% in the two study subsamples. Therefore, there is a need to test for cointegration in the set of variables of both subsamples, developed and developing economies.

Table 5. Pesaran's (2007) CIPS test.

		Developed countries			Developing countries	
		Without trend	With trend		Without trend	With trend
lnGDP	level	-2.663	-2.959		-2.028	-2.442
	First difference	-3.860	-4.253		-4.591	-4.812
lnFD	level	-2.403	-2.848		-2.392	-3.001
	First difference	-5.816	-6.054		-5.796	-6.023
lnFI	level	-2.415	-2.939		-2.617	-3.197
	First difference	-5.708	-5.829		-5.870	-5.979
lnFM	level	-2.824	-2.909		-2.302	-2.605
	First difference	-5.800	-5.920		-5.446	-5.611
lnHC	level	-1.320	-2.529		-1.783	-2.524
	First difference	-1.587	-2.643		-1.849	-2.637
lnPGL	level	-2.233	-2.312		-2.537	-2.583
	First difference	-5.867	-6.000		-5.849	-5.987
lnPE	level	-1.903	-2.964		-1.820	-2.050
	First difference	-5.690	-5.884		-5.391	-5.772

Notes: ***, **, and * denote a significance of 1%, 5% and 10%, respectively. The critical values of CIPS without trend in level are −2.05, −2.11, and – 2.23 for 10%, 5%, and l% level, respectively. The critical values of CIPS with trend in the first difference are −2.55 −2.60, and −2.72 for 10%, 5%, and l% level, respectively.

Table 6 shows the slope homogeneity results (Pesaran & Yamagata, 2008). This approach is used in various studies (Breitung & Salish (2021); Ahmad et al, (2020); Mensah et al (2019); Ando & Bai (2015); Blomquist Westerlund (2013)), prior to cointegration analysis. In this case, the results provide evidence to reject the null hypothesis of homogeneity of the slope, since the probability of the statistics Δ and Δ_{adj} are equal to zero. The null hypothesis ensures that there is homogeneity in the slopes. Homogeneity in the panels is an essential characteristic for the estimators of panel data models to be efficient and unbiased. On the other hand, heterogeneity in the panel slope conditions the use of heterogeneous panel methods to the requirements of efficiency to unbiased, where parameters may change between cross sections.

Table 6. Test for slope homogeneity of Pesaran & Yamagata (2008).

Tests	Delta	p-values
$\tilde{\Delta}$	59.783***	0.000
$\tilde{\Delta}_{adj}$	66.840***	0.000

H0: slope coefficients are homogenous. *t* statistics in brackets * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ and p-value in brackets

Continuing the analysis, Westerlund (2007) developed a panel cointegration test based on error correction that is robust, even in the presence of (CD), commonly known as the second- generation test. The idea of this test is to examine the absence of cointegration by determining whether there is error correction between individual members of the panel (Gt and Ga) or between the entire panel (Pt and Ga). Specifically, the test generates a sample through the Bootstrap method (100) and uses a new sample to construct statistics of the mean of two groups and two panels. The results of each subsample, using each of the financial indicators, reject the null hypothesis of no cointegration and confirm the existence of a balance between the long-term variables (See table 7). In other words, there is a joint variation in economic growth, with each of the financial indicators used (FD, FI and FM), globalization, human capital and non-renewable energy.

Table 7. Results of the Westerlund ECVM error correction model

Variable	Group	Stat	Value	Z-value	P-value	Robust P-value	Cointegration
Financial development	*Developed countries*	Gt	-4.275	-11.336	0.000	0.000	Yes
		Ga	-18.663	-4.407	0.000	0.000	Yes
		Pt	-23.292	-9.768	0.000	0.000	Yes
		Pa	-19.048	-7.602	0.000	0.000	Yes
	Developing countries	Gt	-4.574	-14.271	0.000	0.000	Yes
		Ga	-20.452	-6.264	0.000	0.000	Yes
		Pt	-30.275	-15.248	0.000	0.000	Yes
		Pa	-22.055	-10.768	0.000	0.000	Yes
Financial Institutions	*Developed countries*	Gt	-4.145	-10.532	0.000	0.000	Yes
		Ga	-18.885	-4.532	0.000	0.000	Yes
		Pt	-23.249	-9.729	0.000	0.000	Yes
		Pa	-19.106	-7.647	0.000	0.000	Yes
	Developing countries	Gt	-4.538	-14.029	0.000	0.000	Yes
		Ga	-20.144	-6.007	0.000	0.000	Yes
		Pt	-30.735	-15.673	0.000	0.000	Yes
		Pa	-22.474	-11.121	0.000	0.000	Yes
Financial Markets	*Developed countries*	Gt	-4.227	-11.040	0.000	0.000	Yes
		Ga	-18.736	-4.463	0.000	0.000	Yes
		Pt	-22.727	-9.247	0.000	0.000	Yes
		Pa	-18.769	-7.384	0.000	0.000	Yes
	Developing countries	Gt	-4.546	-14.084	0.000	0.000	Yes
		Ga	-20.628	-6.412	0.000	0.000	Yes
		Pt	-29.773	-14.785	0.000	0.000	Yes
		Pa	-22.007	-10.727	0.000	0.000	Yes

Note: *** denotes significant at the 1% level.

Having determined the cointegration relationship between non-stationary variables, the long-run coefficients must be estimated through cointegration estimators. The present study investigates long-term analysis, which is the key focus of the empirical strategy. This paper uses econometric tools such as fully modified ordinary least squares (FMOLS) estimators and dynamic ordinary least squares (DOLS) estimators. FMOLS and DOLS are highly efficient in dealing with the problem of endogeneity between regressors and serial correlations in the error terms. The FMOLS method uses a non-parametric approach that controls the problem of endogeneity and autocorrelation, while the DOLS method eliminates the problems through the parametric approach by including lags and leads from the explanatory variables (Kao & Chiang, 2000). In particular, the DOLS technique is able to deal with cross-sectional dependence based on obtaining country-specific coefficients and to produce unbiased, efficient and consistent estimates. The results of the FMOLS and DOLS estimators are shown in Table 8 for the two study subsamples and for each of the financial indicators.

Table 8. Results for FMOLS and DOLS

	Developed countries					Developing countries			
	FMOLS		**DOLS**			**FMOLS**		**DOLS**	
Financial Institutions									
FI	0.035* [0.053]	1.940	0.025[0.519]	0.645		0.077*** [0.000]	5.937	0.099*** [0.000]	3.756
HC	2.571*** [0.000]	18.951	2.083*** [0.000]	12.373		0.708*** [0.000]	8.797	0.479*** [0.000]	4.866
PGL	-0.093*** [0.001]	-3.263	-0.057[0.337]	-0.967		0.103*** [0.000]	3.528	0.161*** [0.002]	3.111
PE	0.208*** [0.000]	10.934	0.333*** [0.000]	8.998		0.345*** [0.000]	11.695	0.552*** [0.000]	10.943
Financial Markets									
FM	0.019*** [0.005]	2.839	0.061*** [0.000]	4.511		-0.012* [0.082]	-1.742	-0.022* [0.085]	-1.726
HC	2.464*** [0.000]	18.975	2.035*** [0.000]	12.082		0.747*** [0.000]	8.449	0.576*** [0.000]	5.364
PGL	-0.049*** [0.082]	-1.742	-0.111*** [0.082]	-1.738		0.082*** [0.004]	2.850	0.184*** [0.002]	3.146
PE	0.232*** [0.000]	12.213	0.297*** [0.000]	7.727		0.437*** [0.000]	14.166	0.613*** [0.000]	10.566
Financial Development									
FD	0.018*** [0.000]	4.857	0.046*** [0.000]	5.042		0.032*** [0.008]	2.653	0.011 [0.659]	0.442
HC	0.569*** [0.000]	14.283	0.522*** [0.000]	8.377		0.790*** [0.000]	8.961	0.525*** [0.000]	4.896
PGL	0.419*** [0.000]	48.659	0.403*** [0.000]	20.469		0.084*** [0.004]	2.881	0.166** [0.003]	2.965
PE	0.019*** [0.002]	3.169	0.031** [0.020]	2.328		0.417*** [0.000]	13.439	0.591*** [0.000]	10.378

Note: t statistics in brackets * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ and p-value in brackets

These results show that a financial market based on the presence of FI banking institutions generates a significant impact on developing economies (0.064, $p = 0.000$) at 1%, while the growth of developed economies is benefitted by a financial market based more on the FM stock market, so the impact of FI is not very significant (0.138, $p = 0.043$) in developed economies. On the other hand, developing economies do not benefit from FM, due to no or limited presence of this type of financial market in these economies. Hassan et. al (2011) agree that there has been a positive association between finance and economic growth for developing countries, but contradictory results for high-income countries. Durusu-Ciftci et al (2017) also point out that although the results vary between countries, both the credit market and the stock market have positive long-term effects on the steady-state level of GDP per capita. In this sense, according to the financial structure, the effect of financial development on economic growth is differentiated in the two subsamples analyzed. On the one hand, there are developing economies that are more closely related to the financial market, and on the other hand, developed economies with a stock market that has a more significant impact on economic growth.

However, if we consider financial development as a whole FD, i.e., based on the development of both FI and FM market structures, the impact is significant in developed economies, since the security of the markets can create more active and dynamic financial intermediaries (Durusu-Ciftci et al, 2017). Thus, a market structure where FI and FM have been developed generates such depth in financial activities that they converge in a positive effect on their levels of economic growth. On the contrary, and taking into account that the role of the stock market over banks is strengthened with the development of the financial sector (Chu, 2020), developing economies that do not have a financial structure that boosts both market structures, results in the potential effects of financial development having no impact on the economic growth of these economies.

Human capital is another variable that affects the study subsamples. In fact, in the empirical evidence developed by Ahmed et. al (2020); Khan et. al (2020); Botev et. al (2019) and Quito et al. (2020), it is highlighted that the role of human capital in financial development can generate interaction with technical innovations and support the development of this sector to ultimately promote sustainable economic growth. Particularly in this study, the results show, on the one hand, that in developed economies and with a high presence of FM, there is a greater effect on economic growth. On the other hand, in developing economies, the presence of FI causes human capital to

have a significant impact on the economic growth of these countries at .01% in both estimators. By contrast, if the financial structure is based on the stock market, which is not very developed in developing economies, human capital does not generate any impact on economic growth. In these economies, in addition to human capital, a higher level of financing is required as a necessary condition to generate long-term growth (Ibrahim & Alagidede, 2018).

On the other hand, globalization, which is another control variable, does not generate any impact on the economic growth of developed countries; this same result is observed when considering the FI, FM and FD. Furthermore, in developing economies, a positive effect on economic growth is evident in response to the process of growth and global integration that these countries are currently undergoing. This is contrary to developed economies, where there is already a high level of globalization, which may not exert an effect within these same economies. Berhane (2018) found similar results in a study for a group of countries classified according to their income level, and shows that globalization indices have a positive and significant effect on long-term economic growth in low-income countries, while the relationship is insignificant for upper-middle-income countries, concluding that globalization varies between countries and income levels due to the heterogeneous nature of economic structures, and the way in which countries are integrated in the global economy.

Regarding the use of primary energy, it can be seen that there is a positive and significant effect in both developed and developing economies. Developing economies, which are generally characterized by their growth being based on the use of primary energy, show the largest effect, 0.240 and 0.415 significant at 1% in both estimators, respectively.

Finally, once the long-term relationship is determined, it is important to detect the direction of causality for such relationships. Therefore, the Dumitrescu-Hurlin panel heterogeneous causality test is used to understand the nature of the causal relationship between the study variables. This causality approach is useful for correcting CD and heterogeneity problems (Dumitrescu & Hurlin, 2012). The results of the causality test are described in Table 9. Economic growth has a causal relationship on FD (GDP → FD), a causal relationship that is also evident in developing economies. Likewise, in developing countries, the causal relationship is bidirectional between financial development and economic growth (FD ↔ GDP), mainly due to the characteristics of these economies. These results are consistent with the findings of Christopoulos and Tsionas (2004), who found that the direction is from financial development to growth. Ghirmay (2004) also found similar results for 8 countries in sub-Saharan Africa, verifying that financial development causes economic growth. In addition, our findings are supported by those presented by Gurley and Shaw (1967), Goldsmith (1969) and Jung (1986), who hypothesized that in developing countries, growth drives finances due to the increasing demand for financial services.

Similarly, if we observe the FI, it has a causal relationship with economic growth (GDP → FI), where economic growth has an impact on the FI of developed countries. On the contrary, in developing economies there is a bidirectional causal relationship between these indicators, where a financial sector based on a banking structure impacts on economic growth and vice versa. Precisely Wu et. al (2020), in a study for China found similar results, positive causality that goes from financial development, measured by the amount of private credit lent, to economic growth. In contrast, if we observe FM, it maintains a causal relationship with economic growth, where the latter impacts on FM (GDP → FM) in both developing and developed countries. As Karimo & Ogbonna (2017) find in Nigeria, measuring FM with stock market capitalization ensures that an increase in business activities brings about development of stock market operations, while promoting ownership of securities and efficiency in the stock market.

On the other hand, it is observed that economic growth manages to impact on human capital (GDP → HC); this causal relationship is evident in both developed and developing economies. Thus, the growth of economies would result in an increase in the standard of living, which would provide an improvement in the human capital of the population (Azam, 2019). On the other hand, Fahimi et al. (2018) considers that human capital and economic growth have mutual predictive power, unlike the present result.

Table 9. Dumitrescu-Hurlin causality tests

Null hypothesis	Developed countries				Developing countries		
	W-stat.	p-value	Causality		W-stat.	p-value	Causality
GDP does not homogeneously cause FD	5.366	0.020	GDP → FD		4.218	0.000	GDP → FD
FD does not homogeneously cause GDP	2.879	0.820			5.904	0.000	FD → GDP
GDP does not homogeneously cause FI	5.398	0.020	GDP → FI		3.502	0.060	GDP → FI
FI does not homogeneously cause GDP	3.445	0.560			7.042	0.000	FI → GDP
GDP does not homogeneously cause FM	4.975	0.020	GDP → FM		3.999	0.000	GDP → FM
FM does not homogeneously cause GDP	3.387	0.600			3.576	0.300	
GDP does not homogeneously cause HC	6.356	0.080	GDP → HC		8.903	0.000	GDP → HC
HC does not homogeneously cause GDP	5.051	0.080	HC → GDP		3.450	0.400	
GDP does not homogeneously cause PGL	3.747	0.220			5.866	0.000	GDP → PGL
PGL does not homogeneously cause GDP	5.972	0.020	PGL → GDP		3.581	0.620	
GDP does not homogeneously cause PE	2.069	0.980			2.995	0.500	
PE does not homogeneously cause GDP	6.767	0.000	PE → GDP		5.505	0.000	PE → GDP

If we observe political globalization, we can see a unidirectional relationship that goes from growth to political globalization (GDP → PGL), only in developing economies. This result is similar to that found by Latif et al. (2018) for the BRICS, where growth maintains a causal relationship towards globalization. However, Hassan et al. (2019) found no causal relationship between these variables, for their study in Pakistan. Finally, primary energy manages to impact unidirectionally on economic growth (PE → GDP) of both subsamples. This result is similar to that found by Ozcan et al. (2020) in the OECD, where in addition to presenting such a causal relationship, they find a bidirectional relationship between both variables, which responds to a complementarity between economic growth and primary energy consumption.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

The main objective of this document is to analyze the long-term impact of financial development on economic growth, considering the level of development of case studies by applying cointegration techniques. The analysis includes the Financial Development Index, Financial Institutions Index and Financial Markets as a proxy for financial development; in addition, the use of primary energy, the index of political globalization and human capital are used as control variables. The main findings allow us to conclude that although financial development has a significant impact on the growth of economies, there is an important difference depending on the degree of development of the economy and the proxy that measures financial development. For developing countries, it is evident that the impact of FI is very significant, but not for developed countries, since they benefit more from a financial market based on FM. Both Durusu-Ciftci et al (2017) and Hassan et. al (2011) agree with these findings, highlighting the significant link that connects economic growth with financial development. It is important for public policy makers to consider these findings to ensure sustained growth both in developed economies by increasing financial development towards the stock market, and in developing economies by strengthening institutions to exercise adequate supervision of the stock market sector. Chu (2020) also suggests enacting laws and adopting a countercyclical capital buffer to guide credit growth.

On the other hand, with respect to the control variables, the importance of human capital is highlighted in both developed and developing economies, showing a unidirectional causal link that goes from growth to human capital. Likewise, the use of primary energy is evident for the two groups of countries; a unidirectional impact is also observed. Finally, it is interesting to observe the effect of globalization in political terms. In the case of developed countries, no impact on economic growth is observed, while in developing economies there is a positive effect, mainly due to the process of global integration of economies. Globalization is a key factor in these countries to boost growth, Berhane (2018) emphasizes that active development strategies must be designed and implemented to benefit from the components of globalization with technological innovations, efficiency and economies of scale, but also taking care to counteract the possible negative effects that it can bring.

The limitation of this research is related to the general lack of information for the 81 study countries, especially related to the use of primary energy and political globalization. Given that countries worldwide are making continuous progress in financial issues, it is important for future research to incorporate other factors that measure financial development and its potential for economic growth in their analyses. Analysis can be carried out with more advanced econometric techniques that allow for the inclusion of spatial components.

REFERENCES

Abu-Bader, S., & Abu-Qarn, A. S. (2008). Financial development and economic growth: The Egyptian experience. *Journal of Policy Modeling*, 30(5), 887-898.

Adu, G., Marbuah, G., & Mensah, J. T. (2013). Financial development and economic growth in Ghana: Does the measure of financial development matter? *Review of Development Finance*, 3(4), 192–203.

Ahmed, F., Hossain, M. J., & Tareque, M. (2020). Investigating the Roles of Physical Infrastructure, Financial Development and Human Capital on Economic Growth in Bangladesh. *Journal of Infrastructure Development*, 12(2), 154–175.

Ando, T., & Bai, J. (2015). A simple new test for slope homogeneity in panel data models with interactive effects. *Economics Letters*, 136, 112-117.

Ahmad, M., Jiang, P., Majeed, A., Umar, M., Khan, Z., & Muhammad, S. (2020). The dynamic impact of natural resources, technological innovations and economic growth on ecological footprint: an advanced panel data estimation. *Resources Policy*, 69, 101817.

Azam, M. (2019). Relationship between energy, investment, human capital, environment, and economic growth in four BRICS countries. *Environmental Science and Pollution Research*, 26(33), 34388–34400.

Behera, S. R., & Dash, D. P. (2017). The effect of urbanization, energy consumption, and foreign direct investment on the carbon dioxide emission in the SSEA (South and Southeast Asian) region. *Renewable and Sustainable Energy Reviews*, 70(November 2015), 96–106.

Ben Jedidia, K., Boujelbène, T., & Helali, K. (2014). Financial development and economic growth: New evidence from Tunisia. *Journal of Policy Modeling*, 36(5), 883–898.

Berhane, K. (2018). The role of financial development and institutional quality in economic growth in Africa in the era of globalization. In Determinants of economic growth in Africa (pp. 149-196). Palgrave Macmillan, Cham.

Blomquist, J., & Westerlund, J. (2013). Testing slope homogeneity in large panels with serial correlation. *Economics Letters*, 121(3), 374-378.

Botev, J., Égert, B., & Jawadi, F. (2019). The nonlinear relationship between economic growth and financial development: Evidence from developing, emerging and advanced economies. *International Economics*, 160, 3-13.

Breitung, J., & Salish, N. (2021). Estimation of heterogeneous panels with systematic slope variations. *Journal of Econometrics*, 220(2), 399-415.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics. *The Review of Economic Studies*, 47(1), 239.

Calderón, C., & Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of Development Economics*, 72(1), 321-334.

Cao, X., Kannaiah, D., Ye, L., Khan, J., Shabbir, M. S., Bilal, K., & Tabash, M. I. (2022). Does sustainable environmental agenda matter in the era of globalization? The relationship among financial development, energy consumption, and sustainable environmental-economic growth. *Environmental Science and Pollution Research*, 29(21), 30808-30818.

Carvajal, S. (2015). Fragilidad financiera endógena en economías abiertas y dolarización. Quito: FLACSO Ecuador.

Chu, L. K. (2020). Financial structure and economic growth nexus revisited. *Borsa Istanbul Review*, 20(1), 24-36.

Cuesta-Valiño, P., Gutiérrez-Rodríguez, P., García-Henche, B., & Núñez-Barriopedro, E. (2024). The impact of corporate social responsibility on consumer brand engagement and purchase

intention at fashion retailers. Psychology & Marketing, 41(3), 649–664. https://doi.org/10.1002/mar.21940+

Diallo, B. (2017). Corporate governance, bank concentration and economic growth. *Emerging Markets Review*, 32, 28–37.

Driscoll, J. C., & Kraay, A. C. (1998). Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. *Review of Economics and Statistics*, 80(4), 549–560.

Dumitrescu, E.-I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, 29(4), 1450–1460.

Durusu-Ciftci, D., Ispir, M. S., & Yetkiner, H. (2017). Financial development and economic growth: Some theory and more evidence. *Journal of Policy Modeling*, 39(2), 290–306.

Fahimi, A., Akadiri, S. Saint, Seraj, M., & Akadiri, A. C. (2018). Testing the role of tourism and human capital development in economic growth. A panel causality study of micro states. *Tourism Management Perspectives*, 28(August), 62–70.

Goldsmith, R. W. (1969). Financial structure and development. New Haven, CT: Yale University Press.

Ghirmay, T. (2004). Financial development and economic growth in Sub-Saharan African countries: evidence from time series analysis. *African Development Review*, 16(3), 415-432.

Gutiérrez-Rodríguez, P., Cuesta-Valiño, P., Ravina-Ripoll, R., & García-Henche, B. (2024). Purchase intention of fashion brand retailers: a journey through consumer engagement and happiness. Management Decision, 62(2), 381–402. https://doi.org/10.1108/MD-04-2023-0541

Hashem Pesaran, M., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, 142(1), 50–93.

Hassan, M. K., Sanchez, B., & Yu, J. S. (2011). Financial development and economic growth: New evidence from panel data. *The Quarterly Review of Economics and Finance*, 51(1), 88-104.

Hassan, S. T., Xia, E., Huang, J., Khan, N. H., & Iqbal, K. (2019). Natural resources, globalization, and economic growth: evidence from Pakistan. *Environmental Science and Pollution Research*, 26(15), 15527–15534.

Ho, T. W. (2015). Income inequality may not converge after all: Testing panel unit roots in the presence of cross-section cointegration. *The Quarterly Review of Economics and Finance*, 56, 68-79.

Hodijah, S., & Hastuti, D. (2023). Financial development and economic growth of ASEAN countries during the COVID-19 pandemic. Urbanizing the Regional Sector to Strengthen Economy and Business to Recover from Recession, 21.

Ibrahim, M., & Alagidede, P. (2018). Effect of financial development on economic growth in sub-Saharan Africa. *Journal of Policy Modeling*, 40(6), 1104–1125.

Ibrahim, M., & Alagidede, P. (2018). Effect of financial development on economic growth in sub-Saharan Africa. *Journal of Policy Modeling*, 40(6), 1104-1125.

Ibrahim, M., & Alagidede, P. (2018). Nonlinearities in financial development–economic growth nexus: Evidence from sub-Saharan Africa. *Research in International Business and Finance*, 46, 95-104.

Khan, M. S., & Senhadji, A. S. (2003). Financial development and economic growth: A review and new evidence. *Journal of African Economies*, 12(suppl_2), ii89-ii110.

Khan, Z., Hussain, M., Shahbaz, M., Yang, S., & Jiao, Z. (2020). Natural resource abundance, technological innovation, and human capital nexus with financial development: a case study of China. *Resources Policy*, 65, 101585.

Kao, C., & Chiang, M. H. (2000). On the estimation and inference of a cointegrated regression in panel data. In Advances in Econometrics (Vol. 15).

Karimo, T. M., & Ogbonna, O. E. (2017). Financial deepening and economic growth nexus in Nigeria: Supply-leading or demand-following? *Economies*, 5(1), 1–18.

Kirikkaleli, D., Güngör, H., & Adebayo, T. S. (2022). Consumption-based carbon emissions, renewable energy consumption, financial development and economic growth in Chile. *Business Strategy and the Environment*, 31(3), 1123-1137.

King, R., and Levine, R., (1993). Finance and Growth: Schumpeter Might Be Right, Quarterly Journal of Economics, CVIII.

Latif, Z., Mengke, Y., Danish, Latif, S., Ximei, L., Pathan, Z. H., Salam, S., & Jianqiu, Z. (2018). The dynamics of ICT, foreign direct investment, globalization and economic growth: Panel

estimation robust to heterogeneity and cross-sectional dependence. *Telematics and Informatics*, 35(2), 318–328.

Månsson, K., & Sjölander, P. (2014). Testing for nonlinear panel unit roots under cross-sectional dependency—With an application to the PPP hypothesis. *Economic Modelling*, 38, 121-132.

McKinnon, R., & Shaw, E. (1973). Financial deepening in economic development. Washington, Brookings Institution.

Mensah, I. A., Sun, M., Gao, C., Omari-Sasu, A. Y., Zhu, D., Ampimah, B. C., & Quarcoo, A. (2019). Analysis on the nexus of economic growth, fossil fuel energy consumption, CO2 emissions and oil price in Africa based on a PMG panel ARDL approach. *Journal of Cleaner Production*, 228, 161-174.

Mercan, M., Kızılkaya, O., & Okde, B. (2015). Are The Kaldor's Laws Valid? Panel Data Analysis under Cross Section Dependency for NIC Countries. *Procedia Economics and Finance*, 23, 140-145.

Minsky, H. (1978). The Financial Instability Hypothesis: A Restatement. En Can "It" Happen Again?, Hyman Minsky: 90-116. New York: M. E. Sharpe.

Minsky, H. (1992). The Financial Instability Hypotesis. Jerome Levy Economics Institute of Bard College.

Ozcan, B., Tzeremes, P. G., & Tzeremes, N. G. (2020). Energy consumption, economic growth and environmental degradation in OECD countries. *Economic Modelling*, 84(April), 203–213.

Pedroni, P. (2001). Purchasing Power Parity Tests in Cointegrated Panels. *Review of Economics and Statistics*, 83(4), 727–731.

Pedroni, P. (2004). Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis (Issues 2004–15).

Pesaran H., M. (2004). General diagnostic tests for cross-section dependence in panels. Faculty of Economics, 1240, 1–39.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2), 265–312.

Quito, B., Sánchez, M. L., Ponce, P., García, J. Á., & De, M. (2021). Comparative review of the income gap between the public and private sectors in Ecuador from the equalization policies. *Contaduría y Administración*, 66(4), 1–25.

Robinson, J. (1952). The generalization of the general theory. In The Generalization of the General Theory and Other Essays (pp. 1-76). Palgrave Macmillan, London.

Shahbaz, M., Nasir, M. A., & Lahiani, A. (2022). Role of financial development in economic growth in the light of asymmetric effects and financial efficiency. *International Journal of Finance & Economics*, 27(1), 361-383.

Schumpeter, J. A. (2017). The Theory of Economic Development: An Inquiry into Profits, Capita I, Credit, Interest, and the Business Cycle. Routledge.

Solberger, M. (2011). Demeaning the data in panel-cointegration models to control for cross-sectional dependencies. *Economics Letters*, 110(3), 252-254.

Song, C.-Q., Chang, C.-P., & Gong, Q. (2021). Economic growth, corruption, and financial development: Global evidence. Economic Modelling, 94, 822–830. https://doi.org/10.1016/j.econmod.2020.02.022

Stock, J., & Watson, M. (1993). A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems. *Econometrica*, 61(4), 783–820.

Svirydzenka, K. (2016). Introducing a New Broad-based Index of Financial Development. IMF Working Papers, 16(05), 1. https://doi.org/10.5089/9781513583709.001

Valickova, P., Havranek, T., & Horvath, R. (2015). Financial development and economic growth: A meta-analysis. *Journal of Economic Surveys*, 29(3), 506-526.

Westerlund, J. (2007). Testing for Error Correction in Panel Data. *Oxford Bulletin of Economics and Statistics*, 69(6), 709–748.

Wu, C. F., Huang, S. C., Chang, T., Chiou, C. C., & Hsueh, H. P. (2020). The nexus of financial development and economic growth across major Asian economies: Evidence from bootstrap ARDL testing and machine learning approach. *Journal of Computational and Applied Mathematics*, 372, 112660.

Zhang, J., Wang, L., & Wang, S. (2012). Financial development and economic growth: Recent evidence from China. *Journal of Comparative Economics*, 40(3), 393–412.

Appendix 1. Sample of study countries

Developed countries			*Developing countries*		
Australia	Mauritius		Algeria	India	Tunisia
Austria	Netherlands		Argentina	Indonesia	Turkey
Bahrain	New Zealand		Bangladesh	Iran, Islamic Rep.	Zambia
Belgium	Norway		Benin	Jamaica	
Canada	Panama		Bolivia	Jordan	
Chile	Portugal		Brazil	Malaysia	
Cyprus	Saudi Arabia		Cameroon	Mexico	
Denmark	Singapore		China	Morocco	
Finland	Spain		Colombia	Myanmar	
France	Sweden		Costa Rica	Nepal	
Germany	Switzerland		Cote d'Ivoire	Nicaragua	
Greece	Trinidad and Tobago		Dominican Republic	Nigeria	
Iceland	United Arab Emirates		Ecuador	Pakistan	
Ireland	United Kingdom		Egypt, Arab Rep.	Paraguay	
Israel	United States		El Salvador	Peru	
Italy	Uruguay		Gabon	Philippines	
Japan			Ghana	Senegal	
Korea, Rep.			Guatemala	Sri Lanka	
Luxembourg			Honduras	Thailand	

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Creative Industries and Innovation in Mexican Cities

Industrias Creativas e Innovación en las Ciudades de México

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Abstract

Cities are the main productive space in Mexico. Metropolitan Areas (MA) constitute the urban space with the highest concentration of population and economic activity. Metropolitan Areas are also the privileged place for the concentration of talented people and highly creative economic activities. Creative industries represent more than 3% of employment and, if all creative activities are accounted, this figure exceeds 7% of national employment. Additionally, the rate of growth in these sectors is far superior than that of the national economy, their average annual growth almost doubles the whole economy's growth rate. The aim of this study is to show empirical evidence that the creative activities sector contributes to the reduction of productive inefficiency through innovation, which leads to a productivity growth that improves the competitive situation of firms in cities with greater concentration of talent and creativity. We use the NESTA and UNCTAD methodology to classify creative sectors, then we use a stochastic frontier model to measure the impact that creative industries have on the efficiency, innovation and productivity of Mexican cities. To that end, we studied creative industries in 59 Metropolitan Areas of Mexico, using data from the Economics Census published by the National Institute of Statistics and Geography (INEGI). Our results show that Research & Development, as well as Software, are the creative sectors that generate strong spillover effects on the rest of the activities in Mexican cities, and lead to higher levels of productive efficiency in all productive sectors of the economy.

Keywords: Innovation, productivity, creativity, concentration, metropolitan areas

JEL Code: O30, O40, M54, Z10

Resumen

Las ciudades son el principal espacio productivo de México. Las Áreas Metropolitanas (AM) constituyen el espacio urbano con mayor concentración de población y actividad económica. Las Áreas Metropolitanas son también el lugar privilegiado para la concentración de personas con talento y actividades económicas altamente creativas. Las industrias creativas representan más del 3% del empleo y, si se contabilizan todas las actividades creativas, esta cifra supera el 7% del empleo nacional. Además, la tasa de crecimiento de estos sectores es muy superior a la de la economía nacional; su crecimiento anual promedio casi duplica la tasa de crecimiento de toda la economía. El objetivo de este estudio es mostrar evidencia empírica de que el sector de actividades creativas contribuye a la reducción de la ineficiencia productiva a través de la innovación, lo que conduce a un crecimiento de la productividad que mejora la situación competitiva de las empresas en las ciudades con mayor concentración de talento y creatividad. Utilizamos la metodología NESTA y UNCTAD para clasificar los sectores creativos, luego utilizamos un modelo de frontera estocástica para medir el impacto que tienen las industrias creativas en la eficiencia, innovación y productividad de las ciudades mexicanas. Para ello, estudiamos las industrias creativas en 59 Áreas Metropolitanas de México, utilizando datos del Censo Económico publicado por el Instituto Nacional de Estadística y Geografía (INEGI). Nuestros resultados muestran que Investigación y Desarrollo, así como Software, son los sectores creativos que generan fuertes efectos derrame sobre el resto de las actividades en las ciudades mexicanas, y conducen a mayores niveles de eficiencia productiva en todos los sectores productivos de la economía.

Palabras clave: Innovación, productividad, creatividad, concentración, áreas metropolitanas

Códigos JEL: O30, O40, M54, Z10

1. INTRODUCTION

An interview asked sixty-four of the most important Mexican businesspeople what factors could stimulate productivity growth in the country. They answered that talent was the first factor, infrastructure came second, and digital infrastructure or ICTs came third (Accenture, 2015).

These entrepreneurs were right; talented people have been, and are, a central factor in the development of any economy (Towse & Hernández, 2020; Comunian et al., 2021; Khlystova & Kalyuzhnova, 2023; Swords& Prescott, 2023). Richard Florida widely discussed this (2002) when formulating the concept of creative class. However, when the same Mexican businesspeople questioned how productivity could accelerate their growth, they mentioned that technology, customer connections, and innovation were the most critical levers. The same happens with entrepreneurs as with many scholars on the subject of innovation; they fail to establish a clear connection between talent, creativity, and innovation. Cultural and Creative Industries (CCIs) are fundamentally linked to culture and art as if they were only a part of the amenities of any city (Hesmondhalgh, 2002; Landry, 2008; Garcerán, 2012; Florida, 2014; Dellisanti, 2023), while its main effect is seen as an improvement in the quality of life (Florida, 2004; Pratt, 2008; Montanari, Scapolan, & Mizzau 2018; Pourzakarya, & Fadaei Nezhad Bahramjerdi, 2023; Kalfas et al., 2024).

An essential change in this traditional vision has been the contribution to measuring the impact of the CCIs on the countries' economy and their regions. The Department of Communications and the Arts (Creative Nation: Commonwealth cultural policy, 1994) of the Australian government pioneered the idea that creativity should be taken to economics because it is an essential source of wealth.

Measurements of the relevance of CCIs in the economy have also been made by the Department for Culture, Media and Sport (DCMS) in the United Kingdom (1998), the United Nations Conference on Trade and Development (UNCTAD, 2008), and the work of UNESCO (2005), among many other organizations and institutions.

Despite these crucial efforts to quantify the role of CCIs in the economy, the literature has been mostly limited to studying regional growth, employment, and international trade. Moreover, the products of the CCIs are complex goods due to their high degree of intangibility (UNESCO, 2005), so their benefits are not necessarily expressed in economic values (Hartley, 2005; Hesmondhalgh, 2007; Bakhshi, McVittie, & Simmie, 2008; O´Connor, 2010; Hearn, & McCutcheon, 2020; Burlina et al., 2023). Thus, like entrepreneurs, many economists link innovation and productivity only to traditional industries.

Notwithstanding these constraints from the economic mainstream, it has recently been recognized that CCIs can be highly relevant to innovation in all sectors of the economy (Innocenti & Lazzeretti, 2019). However, this has not translated into a large number of empirical studies, possibly due to what Miles and Green (2008) have called "hidden innovation", to reflect the fact that CCIs give rise to new products, new activities, new business forms, novel combinations of existing processes and technologies, all of which cannot be accounted for through common innovation indicators.

Cities are the main productive space in Mexico. Metropolitan Areas (MA) constitute the urban space with the highest population and economic activity; 85% of the urban population lives there, generating 77.1% of total gross production and 72.6% of total employment.

Metropolitan Areas are also privileged places for the concentration of talented people and highly creative economic activities. Creative industries represent more than 3% of national employment; if all creative activities are accounted for, this figure exceeds 7%. Additionally, the growth rate in these sectors is far superior to that of the national economy; their average annual growth almost doubles the whole economy's growth rate.

In this work, we subscribe to a nontraditional vision under which CCIs play an essential role in innovation. We incorporate our perspective based on stochastic frontier models, which allows us to discover the hidden innovation effect of CCIs through their contribution to greater efficiency in productivity in different sectors of the economy.

The document is divided into five sections. After the introduction presenting the research, section 2 reviews the literature on creativity, innovation, productivity, and efficiency. Section 3 presents the analytical model, and section 4 presents the research results. Finally, section 5 presents the final considerations and recommendations at the policy management level.

2. CREATIVITY, INNOVATION, PRODUCTIVITY AND EFFICIENCY

The link between creativity and innovation should not be the subject of much discussion, given that innovation requires high technical knowledge and creativity. However, mainstream conceptualizations have ignored the role of creative industries by considering that the basis of innovation is the production and demand of goods and leaving aside the role of services and the intangible element that constitutes them (Howkins, 2001; Caves, 2002; Pratt, 2011; Strazdas, Cemeviciute, & Jancoras, 2014).

New perspectives consider that creative industries fulfill three roles in innovation processes: they produce ideas that potentially generate new goods and services, offer services that are inputs of other companies, and are industries intensive in new technology, which promotes innovation (Howkins, 2001; Cunningham, 2002; Müller & Rammer, 2009; Hesmondhalgh & Pratt, 2013; Koch et al., 2023; Krisiukėnienė & Pilinkienė, 2023). This means that how creative industries give rise to innovation processes is quite complex, so not any product of CCIs leads to innovation. Although creative products may represent new ideas, they do not become innovative if they do not meet market needs, their relevance is not recognized socially, or they are not successfully accepted and implemented (Dowejko & Xiao, 2018; Huang & Zou, 2023).

The link between productivity growth and innovation has traditionally been discussed within approaches that take Solow's (1957) model as a starting point. Results from these studies suggest that changes in productivity are not only due to the increase in the factors of production (labor and capital) but also due to a residual part called technical change. In Solow's residual, practically anything fits, and empirical studies have included improvements in the quality of work and capital, as well as Research and Development, among other elements, in this residual (Hall, 2011). This has led to the argument that the residual part generates innovation. Consequently, studies on the subject have used Research and Development or patents as proxy variables for innovation processes. However, Barro and Sala-i-Martin (2003) point out that these approaches are simple accounting approaches, under which it is impossible to discern whether changes in productivity are generated by technical change or by improvements in efficiency.

Although productivity is defined simply as the quantity produced per input unit, its measurement is complicated. A central problem resides in the fact that the product is not reported as a quantity in national accounts but as the monetary value of the production; therefore, any ratio built with that indicator leads us to what could be called monetary productivity. Secondly, the inputs used in its measurement would only make some sense for incorporating work. Meanwhile, the aggregate production function, in which capital is used to measure Total Factor Productivity, has been criticized for lacking solid theoretical foundations and being considered fictitious (Felipe & McCombie, 2005; Block, 2022).

To overcome the limitations above, this research uses the most widely used and less-*questified* indicator, monetary labor productivity, defined as the ratio of value added per employed person. Either way, in any productivity indicator, the established ratio of output to inputs does not indicate anything about production efficiency. The consequence is that when efficiency is not considered, the analysis of productivity growth will be biased and lack precision, as pointed out by Grosskop (1993), Nordhaus (2003), and Gordon (2016). To circumvent these shortcomings, we calculate the monetary labor productivity of the 59 metropolitan areas of Mexico[1] but also generate an efficiency measure through stochastic frontier models (Kumbhakar, Denny & Fuss, 2000). The advantage of these models is that efficiency can be conditioned to its causal factors, within which we can include CCIs.

In this way, it will be possible to evaluate whether CCIs contribute to reducing productive inefficiency in cities with the highest concentration of talent and creativity. The evidence for Mexican cities is very scarce; the only precedent for Mexico is the works of Borrayo and Quintana (2017) and Valdivia et al. (2020), who apply the stochastic border method and condition the efficiency indicator to an aggregate of creative activities.

This study extends the work above by Borrayo and Quintana to study the technical efficiency of the 59 metropolitan areas of Mexico and updates the proposal of Valdivia et al. (2020). We expand on the disaggregation of creative sectors since some have different weights on cities' productivity, competitiveness, and efficiency. In particular, we incorporate CCI segmentation into Arts, Services (creative), Software, Research and Development (R&D), and Entertainment. This segmentation, in turn, is a proxy for the concentric classifications of CCIs, where Arts would form the central circle and "furthest" from the market, while the (creative) service segment and software would be located on the outermost circles.[2]

3. ANALYTIC MODEL

Productive differences between companies, even in the same sector and product, can be explained in terms of efficiency, and the presence of CCIs in this research will express part of this.

To this end, we specify a stochastic production frontier model with panel data using the procedure of Kumbhakar et al. (2015) and the routines of Belotti et al. (2013). The model defines a vector x_i of input variables that determine the levels of monetary labor productivity. Even if the input vector x_i were

[1] We use all 59 metropolitan areas of Mexico as defined by CONAPO (2010) (see Annexes 1 and 2).

[2] Throsby (2008) proposed the idea of concentric circles. Creative arts would locate at the core circle, while more commercial disciplines would move away in concentric circles, gradually reducing the extent of the cultural.

precisely the same for different producers, it is still possible and likely that differences exist between the observed product y_i and the potential product. That difference is defined as the technical efficiency (ET), while technical inefficiency would be described as $IT = 1 - ET$.

To estimate these models, we formulate a labor productivity function such as the following (Battese & Coelli, 1995):

$$\ln (y_{it}/po_{it}) = ln\, f(x_{it,}\delta_{it}; \beta) - u_{it} + v_{it} \ldots (1)$$

Where y_i is the value added of metropolitan area i, po_i is employed population in metropolitan area i, x_i is the capital-labor ratio, and δ_i is a productive diversification indicator that accounts for the effects of Jacobs-type externalities on the productivity of cities.3

The error term has two components, a random disturbance term v_{it} with a normal distribution that complies with the assumptions of being independent, identically distributed, and having zero mean and constant variance $[iid\ N(0, \sigma_v^2)]$, and a random variable u_{it} that captures the effects of technical inefficiency in production and is distributed independently according to a normal distribution truncated in negative values, with a mean m_{it} that has the characteristic of existing between zero and one, and with a constant variance $N(m_{it}, \sigma_u^2)$.

The Battese and Coelli (1995) methodology allows specifying the levels of expected or average inefficiency $E(u_{it}) = m_{it}$ as a function of a set of variables z_{it} among which is the presence of the creative sectors and the effect of sectoral diversification:

$$E(u_{it}) = z_{it}\delta + \varepsilon_{it} \qquad (2)$$

We use equations (1) and (2) to analyze the relevance of the creative sectors in technical efficiency and in determining labor productivity in the 59 metropolitan areas of Mexico. The variables used to condition equation (2) of inefficiency are disaggregated according to the five creative sectors defined. We introduce a diversification index to capture the effect of Jacob-type externalities.

Table 1 shows the classification used for CCIs, following the North American Industrial Classification System used in the Mexican Economic Census. The classification is based on the one proposed by the Orange Economy (Buitrago & Duque, 2013), which is more closely linked to the conditions of the creative sectors in Latin America. We exclude gastronomy and include R&D to broaden the classification beyond the limits imposed by the cultural sector. This broader classification encompasses technological sectors that are essential for understanding innovation processes in production (Bakhshi, Benedikt & Osborne, 2015; Valdivia et al., 2020).

[3] For Jacobs (1970) a high productive diversification will lead to further growth, due to increasing sectoral competition.

Table 1. Classification of Cultural and Creative Industries

Subsector/Group/Industry*	
ART	
512	Film and video industry and sound industry
7111	Artistic and cultural entertainment companies and groups
7115	Freelance artists, writers, and technicians
51912	Libraries and archives
54131	Architecture
71211	Museums
71212	Historical sites
71213	Botanical gardens and zoo
SERVICES	
511	Publishing of newspapers, magazines, books, software and other materials, and editing of these publications integrated with printing
515	Radio and television
5414	Specialized design
5418	Advertising services and related activities
7113	Promoters of artistic, cultural, sports and similar shows
51911	News agencies
54191	Market research and public opinion polling services
SOFTWARE	
518	Electronic information processing, hosting and other related services
5415	Computer systems design services and related services
51913	Editing and dissemination of content exclusively through the Internet and online search services
R+D	
5413	Architectural, engineering and related activities services
5417	Scientific research and development services
54162	Environmental consulting services
54169	Other scientific and technical consulting services
ENTERTAINMENT	
7114	Agents and representatives of artists, athletes and the like
7131	Parks with recreational facilities and electronic games houses
7132	Casinos, lotteries and other games of chance
7139	Other recreational services

* Subsector=3 digits, Group=4 digits, Industry=6 digits

Source: Prepared by the authors based on the North American Industrial Classification System (INEGI, 2020), Nathan, Kemeny, Pratt, & Spenser (2016), Valdivia et al. (2020), and UNCTAD (2008).

Equation (1) is estimated in terms of labor productivity, which is specified using a Cobb-Douglas function, linearized using natural logarithms:

$$\ln\left(VACB_{it}/PO_{it}\right) = \alpha_0 + \beta_1'\ln\left(ABKF_{it}/PO_{it}\right) + \beta_2'\ln\left(Diver_{it}\right) + \left(v_{it} - u_{it}\right) \ldots (3)$$

The dependent variable is the monetary labor measured by the logarithm of the ratio between real gross value added (VACB) and employed population (PO) for 2003, 2008, 2013, and 2018. The input variable was calculated as the ratio of gross fixed capital stocks (ABKF) to the employed population of each MA for the same years. Finally, the variable that allows us to capture the effect of Jacobs-type externalities is a diversification index (Divers) calculated as the inverse of the Hirshcman-Herfindal index (IHH).4

The technical inefficiency model (Eq. 2) associated with the stochastic boundary (Eq. 1) is specified as follows:

$$u_{it} = \gamma_0 + \gamma_1 \cdot AR_{it} + \gamma_2 \cdot SER_{it} + \gamma_3 \cdot SOFT_{it} + \gamma_4 \cdot R\&D_{it} + \gamma_4 \cdot ENTR_{it} + \gamma_5 Diver_{it} \cdot \ldots (4)$$

Where AR_{it} is the population employed in creative art activities in metropolitan area i in year t; SER_{it} is the population working in creative services; $SOFT_{it}$ is employed population in the software sector; $R\&D_{it}$ is employment in the research and development sector, $ENTR_{it}$ is employed population in entertainment activities and $Diver_{it}$ is the diversification index.

[4] The IHH was calculated using all subsectors (three-digit classification) of the manufacturing industry for each of the 59 metropolitan areas. Through the sum of the squared shares of these subsectors, the IHH indicates the degree of sectoral concentration in each metropolitan area, while 1-IHH represents the degree of manufacturing sectoral diversification.

4. LABOR MONETARY PRODUCTIVITY AND PRODUCTIVE EFFICIENCY

4.1 Trends in labor productivity

Labor productivity in the 59 metropolitan areas of Mexico (MA), measured as the ratio of real gross value added (VACB) to employed population (PO), has had a decreasing trend throughout the period 2003-2018. This trend is due to the consistent reduction in productivity during the periods between the economic censuses, 2003-2008, 2003-2013, and 2003-2018 is shown as negative growth rates of -2.4%, -1.9%, and -0.8 for each inter-census period respectively; See Table 2. These results are not surprising for the country; labor productivity in Mexico is the lowest of all OECD countries. According to this organization, 24 dollars is produced for each hour of work in Mexico, while the average for all OECD countries is $67.5 (OECD, 2024).

Table 2 establishes that most metropolitan areas have low productivity and negative growth rates. It also shows that the regions with above-average productivity, at 75% (3rd quintile) of the distribution, presented the smallest decreases in productivity and even improved their productivity levels in the last period. However, the latter contrasts with the fact that the sharpest drop in productivity occurred in the MA with the highest level of productivity.

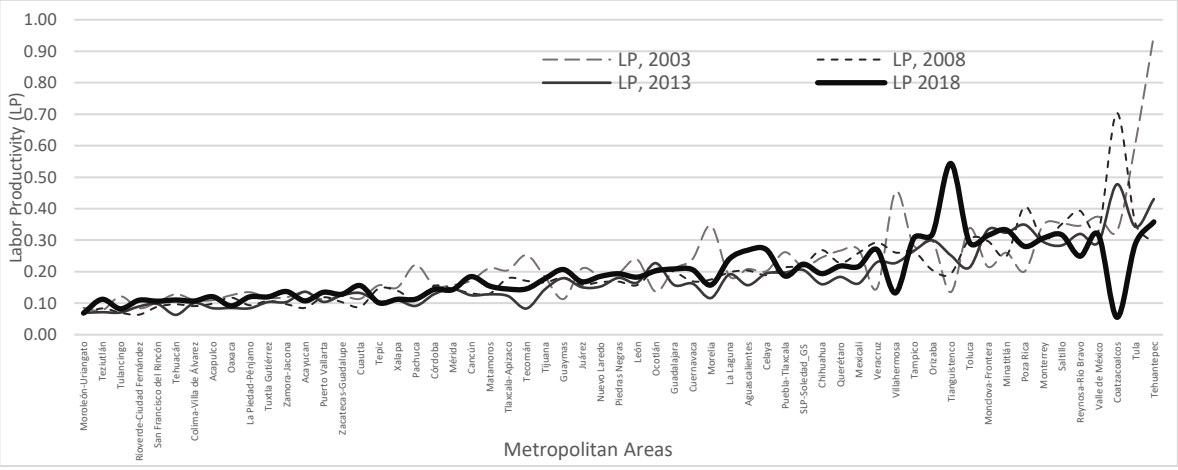
Table 2. Stylized facts of labor productivity ($VACB_{it}/PO_{it}$) 2003-2018

	2003	2008	2013	2018	2003-2008	2003-2013	2003-2018
					average annual rate (%)		
minimum	0.08	0.06	0.06	0.06	-3.4	-1.8	-1.9
1st quintile	0.10	0.08	0.07	0.09	-3.9	-3.1	-0.8
mean	0.22	0.20	0.18	0.19	-2.4	-1.9	-0.8
median	0.20	0.17	0.16	0.18	-3.0	-2.2	-0.6
3rd quintile	0.26	0.26	0.23	0.27	-0.2	-1.3	0.2
maximum	0.95	0.70	0.48	0.54	-5.2	-5.0	-2.9
standard dev.	0.14	0.11	0.09	0.09	-4.3	-3.2	-2.3

Source: Author's estimates were based on the data from the Economic Censuses of 2004, 2009, 2014, and 2019.

To analyze these results in greater detail, we sorted MAs from lowest to highest on labor productivity, according to the 2018 census indicators. Figure 2 shows the productivity reference levels for 2018 (black line), compared to the observed productivity in the 2013 census (red line), the 2008 census (blue line), and the 2003 census (green line).

Figure 1. Labor productivity (PT) in metropolitan areas, 2003-2018



Source: Authors using data from the Economic Censuses of 2004, 2009, 2014, and 2019.

The graph shows that no single leader has the highest productivity value over the entire period: Tehuantepec was the leader in 2003, Coatzacoalcos in 2008 and 2013, and Tianguistenco in 2018. These cities traditionally have significant industrial developments, such as the oil industry in Coatzacoalcos or the automotive sector in Tianguistenco, or they produce energy and agricultural products, such as Tehuantepec.

There is a clear pattern in the behavior of productivity among metropolitan areas; in those with the lowest levels of productivity, the trend over time has been towards growth over the years, as can be seen in the first fifteen metropolitan areas that go from Moroleón to Cuautla in Figure 1; it can be seen that, in general, productivity in 2018 is higher than in previous years. A second group with intermediate productivity levels deteriorated slightly between 2003 and 2013, ranging from the metropolitan areas of Tepic to Mexicali. Finally, a group with high levels of productivity whose current levels are well below those that prevailed in previous years are the areas that go from Poza Rica to Tehuantepec.

In conclusion, the general trend of declining labor productivity in the metropolitan areas of Mexico is characterized by three groups: one of low labor productivity and negative growth rates (between the minimum and 1st quintile), another of productivity around the mean (3rd quintiles) with moderate decreasing trends in productivity and recovery in the last period, and a last group of areas with high labor productivity and sharp declines between the years 2003 and 2018.

4.2 Econometric results of the productive frontier and technical efficiency model

As discussed in the first section of this chapter, productivity growth does not necessarily indicate an efficient evolution, nor does it imply innovation in production.

To evaluate the efficiency levels of labor productivity in the country's metropolitan areas, we estimated the stochastic production frontier model corresponding to equations (3) and (4). To evaluate the effects of innovation from the creative sectors, we conditioned equation (4) on the size of the creative sectors in the different metropolitan areas to account for the intangible effects of these sectors on productive innovation and efficiency.

In the results of Table 3 for the production frontier function, we confirmed that labor productivity is positively related to capital density (capital per employed person or capital-labor ratio). Thus, increases (decreases) in the capital-labor ratio will result in increases (decreases) in output per employed person or monetary labor productivity in metropolitan areas. Since the coefficient is statistically different from zero or significant, it is interpreted as follows: at a 10% increase in capital density, labor productivity will increase by 4.6%. This means that the capital investment capacity in cities is the fundamental engine for labor productivity growth.

Also, in Table 3, we observe that the effect of Jacobs-type externalities, although negative, was insignificant since the coefficient of the diversification variable could be considered zero. This means that Mexican cities fail to fully exploit agglomeration economies, and, therefore, there is a potential level of productivity that needs to be exploited.

In the part of the model where the average behavior of inefficiency is explained (Mu in Table 3); the coefficients of the five creative segments determining the level of technical efficiency of each MA are highly significant. Furthermore, the effect of the variable Diversification is significant, indicating that Jacobs-type economies operate on productivity efficiency levels. The inference of these results suggests that research and development in metropolitan areas, together with software development and productive diversification, are the factors that contribute to reducing technical inefficiency in cities and, consequently, to improving their efficiency as a competitive position, which is verified by the negative sign obtained in both coefficients. Art and creative services have a positive effect on increasing productive inefficiency, which could be explained by the low linkage of these sectors with manufacturing in Mexican cities.

Regarding the results for the variances, it was found that the creative activity of entertainment was significant and negative for both the production frontier and the technical inefficiency of the model. From an analytical point of view, these results imply that entertainment activities have a positive effect in reducing inequality in labor productivity and inefficiency among Mexican MAs. The positive role of

entertainment can be understood as a positive effect on the quality of life. Creating entertainment zones in cities encourages local culture and attracts talented people looking for new ways of life in urban areas (Stevenson, 2006).

Table 3. Impact of creative sectors on productive efficiency 2003-2018

Endogenous Variable: Ln(VACB/PO)				
Frontier	**Coefficient**	**P>z**	**Coefficient**	**P>z**
Ln(AKF/PO)	0.460	0.00	0.489	0.00
Ln(Diversification)	-0.106	0.61		
Constant	-0.733	0.00	-0.675	0.00
Inefficiency measure (Mu)				
Ln(Art)	0.401	0.38	-0.762	0.00
Ln(Entertainment)	0.744	0.00	0.459	0.00
Ln(R&D)	-1.005	0.16	-0.872	0.07
Ln(Services)	1.211	0.01	0.598	0.02
Ln(Software)	-1.253	0.14	-1.180	0.05
Ln(Diversification)	-2.525	0.01		
Inefficiency Variance (Sigma_U)				
Ln(Art)	1.967	0.00	2.620	0.00
Ln(Entertainment)	-3.681	0.00	-4.023	0.00
Frontier Variance (Sigma_V)				
Ln(Art)	0.738	0.12	0.725	0.17
Ln(Entertainment)	-5.254	0.00	-5.488	0.00
E(sigma_u)	0.595		0.646	
E(sigma_v)	0.306		0.289	

Source: Authors' estimates were based on the 2004, 2009, 2014, and 2019 Economic Census data.

4.3 Technical efficiency Analysis

We observed that average technical efficiency levels increased slightly from 77% to 78% from 2003 to 2018. However, they had decreased in the intervening periods (see the mean in Table 4), where part of the increasing trend in average labor productivity is explained by productive investment in medium-sized cities. Thus, there is a chance to improve productivity in all the cities by promoting creative and cultural industries and taking advantage of the economies of scale generated by the diversification of local economies.

Drawing from our results, work productivity has an overall average efficiency level of 78%, equivalent to an inefficiency of 22% in cities. At the same time, we found that both minimum and maximum efficiency levels tend to decrease over time, in such proportion that the standard deviation tends to be relatively stable between cities during the study period.

Table 4. Stylized facts of technical efficiency, 2003-2018

	2003	2008	2013	2018	2003-2008	2003-2013	2003-2018
					average annual rate (%)		
minimum	0.48	0.40	0.41	0.25	-3.4	-1.6	-3.3
1st quintile	0.54	0.51	0.53	0.59	-1.2	-0.3	0.5
mean	0.77	0.76	0.75	0.78	-0.3	-0.2	0.1
median	0.80	0.80	0.77	0.83	0.0	-0.3	0.3
3rd quintile	0.88	0.88	0.86	0.89	-0.1	-0.3	0.1
maximum	0.97	0.96	0.96	0.95	-0.2	-0.1	-0.2
standard dev.	0.13	0.14	0.13	0.14	1.3	-0.6	0.2

Source: Authors' estimates using the efficiency component of the stochastic frontier model.

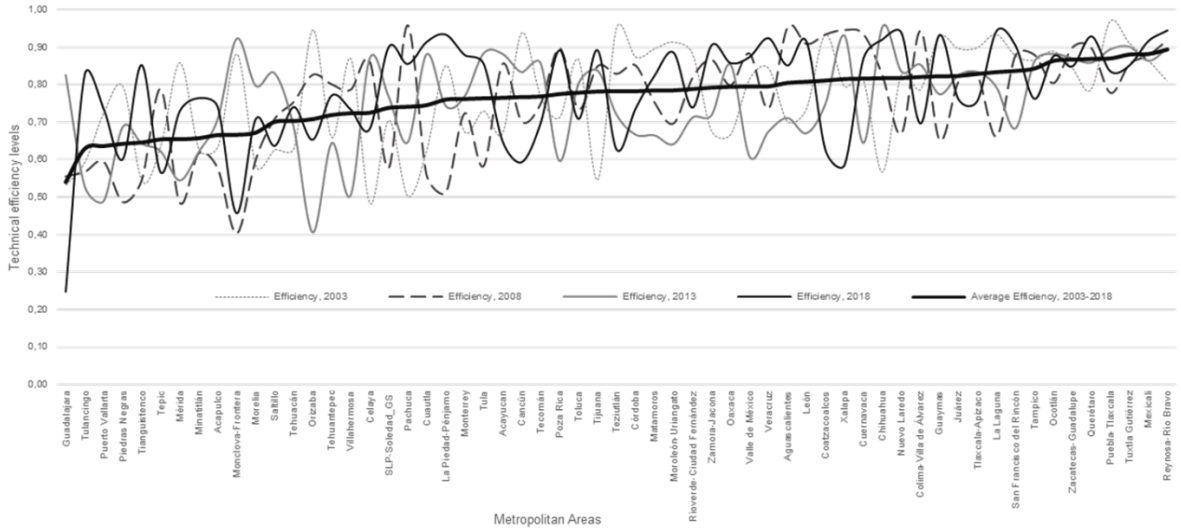
Figure 2 shows the hierarchical ordering (ranking) of efficiency levels in the average 2003-2018 and the levels corresponding to the years 2018, 2013, 2008, and 2003. With the ranking of the average 2003-

2018, it can be seen that the highest levels of efficiency occurred in cities in the north of the country (Mexicali & Reynosa) and in some industrial towns (Queretaro, Puebla & Zacatecas), which are linked to the export trade route with the United States and have a highly industrial component. The higher urban concentrations in the country, Mexico City, and the Monterrey Metropolitan Area have an intermediate position.

Notably, the most efficient metropolitan area is Reynosa, a city strategically located in the north region, with an excellent export activity of the electronics and auto parts industries to the United States.

Figure 2 shows that the least efficient city is Guadalajara, one of the country's large industrial areas. This result would point to the effect of the international crisis on Mexico after 2008, which devastated the economy by reducing the GDP growth rate by more than 5%, representing one of the worst economic collapses in recent years. The anti-crisis plans designed by the Mexican government in 2009 (Program to Promote Growth and Employment and the National Agreement in Favor of Employment and the Family Economy) were insufficient. They were described as a lesser effort than those carried out in other Latin American economies, which achieved a faster recovery (Isaac & Quintana, 2010).

Figure 2. Technical Efficiency Levels in Metropolitan Areas, 2003-2018



Source: Authors' estimates using the efficiency component of the stochastic frontier model.

5. FINAL CONSIDERATIONS

The contribution of CCIs to Mexico's GDP and value-added growth is still modest, especially compared with the United Kingdom, Australia, and other Asian countries, where an advanced sector of CCIs has been consolidated. However, this work has shown that the CCIs in Mexico could play a highly relevant role in the immediate future of cities, being a determining factor in innovation, efficiency, and productive growth.

The CCIs do not perform homogeneously; therefore, in this study, we segmented them into five groups to analyze their impacts on efficiency and productivity throughout the fifty-nine metropolitan areas of Mexico. The results clearly showed a heterogeneous behavior of the CCIs, led by the creative Services segment and followed by Entertainment.

One of our main conclusions is that, despite the considerable variability and decreasing trends in technical efficiency and labor productivity in Mexico's metropolises, a boost to the production activities of Software and Research and development would significantly increase technical efficiency and labour productivity in Mexican cities.

The country's metropolitan areas concentrate 85% of the urban population, 77.1% of its gross production, and 72.6% of employment. Consequently, what happens with their economies at the local level will have a high impact on the whole country's economic processes.

Our results allow us to infer that the primary determinant of productivity is capital density, which implies that capital investment is crucial to increasing the productive capacity of the country: a 10% increase in the capital-labor ratio becomes a 5% increase in urban productivity. However, for this investment effort to achieve high levels of efficiency, it requires the drive of innovation processes linked to CCI since these are the ones to achieve a high concentration of talented people and new ideas.

The results of our efficiency model point out that, in particular, the Software and Research and Development segments are potential drivers through which CCIs could generate innovation processes and increase productive efficiency in cities. We have also found that a sector traditionally linked to leisure, such as the Entertainment segment, plays a crucial role in improving the quality of life in cities and contributes to reducing inequality in the processes of productive growth by attracting talented people.

Productivity and growth have been associated with how agglomeration economies operate in cities. This work shows that economic diversification, with Jacobs-type externalities, is relevant in reducing productive inefficiency by harnessing economies of scale. However, diversification does not directly impact productivity levels, suggesting an untapped potential for city economic growth.

In sum, it is possible to affirm that CCIs will become a key element in the immediate future of Mexican cities. Therefore, public policy should strive to create the best conditions for talent, innovation, and the creative processes associated with these industries to flourish in the country. Implementing public policies to improve the conditions for talent, innovation, and creative processes in Mexico's Cultural and Creative Industries (CCI) requires a multi-faceted approach. Fiscal and financial incentives, such as credits, grants, and tax exemptions, are essential to support startups and small companies in the Software, Research and Development (R&D) and Entertainment sectors. In addition, creating innovation funds can facilitate access to venture capital for innovative projects. Education and training should be strengthened through training programs in digital and creative skills, promoting STEAM education (Science, Technology, Engineering, Art, and Mathematics) and providing continuous courses and workshops for sector professionals. Improving technological infrastructure, such as high-speed internet access, and establishing technology parks and innovation centers are crucial to providing technical support.

Furthermore, fostering networks and collaborations, both nationally and internationally, can enhance exchanging ideas and resources. Creative clusters and public-private partnerships are effective strategies for developing sustainable CCI projects. Through legislative strengthening and legal advice, intellectual property protection ensures that creators can benefit from their innovations. Promotion and visibility of CCIs through festivals, fairs, marketing campaigns, and digital platforms are fundamental to highlighting their impact on the economy. Finally, a favourable regulatory environment, the simplification of bureaucratic procedures, and urban revitalization that integrates art and culture can improve the quality of life and attract talent, consolidating CCIs as a critical element in the future development of Mexican cities.

Despite the robustness and applicability of the stochastic production frontier model with panel data following the procedures of Kumbhakar et al. (2015) and the routines of Belotti et al. (2013), its use has several inherent limitations. One of the main restrictions lies in the specific assumptions about the distribution of the inefficiency term, which, if not met, may lead to biased and inconsistent estimates. In addition, the choice between fixed or random effects may significantly influence the results, and unbalanced panel data may affect the robustness of the estimates. An additional challenge in our study is the temporal limitation of the data, which covers only 2003 to 2018. This temporal constraint is significant given that we are in the year 2024, and the lack of recent data in the database may prevent an up-to-date and relevant assessment of efficiency, omitting possible changes in technology and the economic environment that have occurred in recent years. Therefore, it is crucial to consider these limitations when interpreting the results obtained and designing future research.

Our research underscores the significance of creative industries and innovation in Mexican cities. It is crucial to consider various factors such as the creative classes (Florida, 2002 and 2004), the Orange Economy, the cultural industry, human capital, management, entrepreneurship, and business models (Rodríguez-Insuasti, Homero et al., 2022; Rodríguez-Insuasti, Homero et al., 2023) in forthcoming research.

REFERENCES

Bakhshi, H., McVittie, E., & Simmie, J. (2008). *Creating Innovation: Do the creative industries support innovation in the wider economy?* (pp. 1-40). London: Nesta.

Barro, R., & Sala-i-Martin, X. (2003). Economic growth, volume 1 of MIT Press Books. Cambridge, MA.

Battese, G.E., & Coelli, T.J. (1995). A model for technical inefficiency effects in a stochastic frontier production for panel data. *Empirical Economics*, 20(2), 325-332.

Belotti, F., Daidone, S., Ilardi, G., & Atella, V. (2013). Stochastic frontier analysis using stata. *The Stata Journal*(4), 719-758.

Block, F. (2022). Technology and productivity: a critique of aggregate indicators. *Journal of Post Keynesian Economics*, 45(1), 1–23. https://doi.org/10.1080/01603477.2022.2029491

Borrayo, R., & Quintana, L. (2017). Creatividad, eficiencia y concentracion espacial en México. *Problemas del Desarrollo*, 49(193), 33-66.

Buitrago, F., & Duque, I. (2013). The Orange Economy. Inter-American Development Bank, Working Paper IDB-MG-165.

Burlina, C., Casadei, P., & Crociata, A. (2023). Economic complexity and firm performance in the cultural and creative sector: Evidence from Italian provinces. *European Urban and Regional Studies*, 30(2), 152-171.

Caves, R.E. (2002). *Creative Industries: Contracts between Art and Commerce*. Harvard University Press.

CEPAL (2016). Productividad y brechas estructurales en México. CEPAL. Retrieved from https://repositorio.cepal.org/bitstream/handle/11362/40165/1/S1600553_es.pdf

Comunian, R., England, L., Faggian, A., & Mellander, C. (2021). *The economics of talent: Human capital, precarity and the creative economy*. Springer Nature.

CONAPO (2010). Sistema Urbano Nacional. México: Consejo Nacional de Población (CONAPO).

Cunningham, S. (2002). From Cultural to Creative Industries: Theory, Industry, and Policy Implications. *Media International Australia Incorporating Culture & Policy*, 102(1), 128-138.

DCMS (1998). Creative Industries Mapping Document. Reino Unido: Department for Culture, Media and Sport.

Dellisanti, R. (2023). *Cultural and Creative Industries and Regional Development. Cultural and Creative Industries and Regional Development*. Springer International Publishing. Retrieved from: https://doi. org/10.1007/978-3-031-29624-6.

Department of Communications and the Arts (Australia) (1994). Creative Nation: Commonwealth cultural policy. *Analysis and Policy Observatory*. Retrieved from: https://apo.org.au/node/29704.

Dowejko, K. M., & Xiao, Y. (2018). Time To Be Innovative, Hong Kong: Time Orientation, Creativity and Entrepreneurial Activities. In A. K.-Y. Leung, L. Y.-Y. Kwan, & S. Liou, *Handbook of culture and creativity: basic processes and applied innovations* (pp. 293-320). New York: Oxford University Press.

Felipe, J., & McCombie, J. (2005). La función de producción agregada en retrospectiva. *Investigación Económica*, 64(253), 43-88.

Florida, R. (2002). THE Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life . Basic Books.

Florida, R. (2004). *La clase creativa. La transformación de la cultura del trabajo y del ocio en el siglo XXI* (Vol. 117). Grupo Planeta (GBS).

Florida, R. (2014). The creative class and economic development. *Economic Development Quarterly*, 28(3), 196-205.

Garcerán, A. M. (2012). El triunfo de las ciudades. *Nueva revista de política, cultura y arte*, (138), 77-86.

Gordon, R. J. (2016). *The rise and fall of American growth: The U.S. standard of living since the Civil War*. Princeton University Press.

Grosskop, S. (1993). *Efficiency and Productivity, the measurement of productive efficency: techniques and applications*. Oxford University Press.

Hall, H. B. (2011). Innovation and Productivity. California, USA: NBER Working Paper No. 17178.

Hearn G. & McCutcheon, M. (2020). *The creative economy: the rise and risks of intangible capital and the future of creative work*, Chapter 2 in Hearn (ed.) The Future of Creative Work, Edward-Elgar, DOI: https://doi.org/10.4337/9781839101106

Hartley, J. (2005). *Creative Industries*. Blackwell Publishing.

Hernández García, S., Cruz González, G., Arroyo Osorno, J. A., González García, J., & Torres Vargas, G. (2016). *Productividad laboral en el Istmo de Tehuantepec, localización y conexión al Corredor Transístmico.* Coordinación de Economía de los Transportes y Desarrollo Regional del Instituto Mexicano del Transport, Publicación Técnica (472).

Hesmondhalgh, D. (2002). *The Cultural Industries*. Sage Publications.

Hesmondhalgh, D. (2007). Cultural and Creative Industries. In *Handbook of Cultural Sociology* (pp. 413-427). Routledge.

Hesmondhalgh, D., & Pratt, A.C. (2013). Cultural Industries and Cultural Policy. *International Journal of Cultural Policy*, 19(4), 365-373. https://doi.org/10.1080/10286632.2012.709571

Howkins, J. (2001). *The Creative Economy: How People Make Money from Ideas*. Penguin UK.

Huang, E. X., & Zou, X. (2023). How do CCIs contribute to regional innovation?. *International Journal of Innovation Science*, (ahead-of-print).

IMCO (2016). Índice de competitividad urbana. Retrieved from: https://imco.org.mx/wp-content/uploads/2016/09/2016-Indice_Competitividad_Urbana-Documento.pdf

INEGI. *Sistema de Clasificación Industrial de América del Norte 2018 (SCIAN 2018)*. Retrieved from: https://www.inegi.org.mx/app/scian/ (3 de March de 2020)

Innocenti, N., & Lazzeretti, L. (2019). Do the creative industries support growth and growth and innovation in the wider economy? Industry relatedness and employment growth in Italy. *Industry and Innovation*, 26(10), 1152-1173.

Isaac, J., & Quintana, L. (2010). ¿Puede ser peor? La dimensión regional de la crisis. *Metapolítica*, 12(69), 67-75.

Jacobs, J. (1970). *The economy of the cities*. New York: Vintage Books.

Kalfas, D., Kalogiannidis, S., Ambas, V., & Chatzitheodoridis, F. (2024). Contribution of the Cultural and Creative Industries to Regional Development and Revitalization: A European Perspective. *Urban Science*, 8(2), 39.

Khlystova, O., & Kalyuzhnova, Y. (2023). The impact of the creative industries and digitalization on regional resilience and productive entrepreneurship. *The Journal of Technology Transfer*, 48(5), 1654-1695.

Koch, F., Hoellen, M., Konrad, E. D., & Kock, A. (2023). Innovation in the creative industries: Linking the founder's creative and business orientation to innovation outcomes. *Creativity and Innovation Management*, 32(2), 281-297.

Krisiukėnienė, D., & Pilinkienė, V. (2023). Theoretical presumptions of the creative industries innovation productivity performance. *Creativity Studies*, 16(1), 91-107.

Kumbhakar, S.C., Denny, M., & Fuss, M. (2000). Estimation and decomposition of productivity change when production is not efficient. *Econometrics Reviews*, 19(4), 425-460.

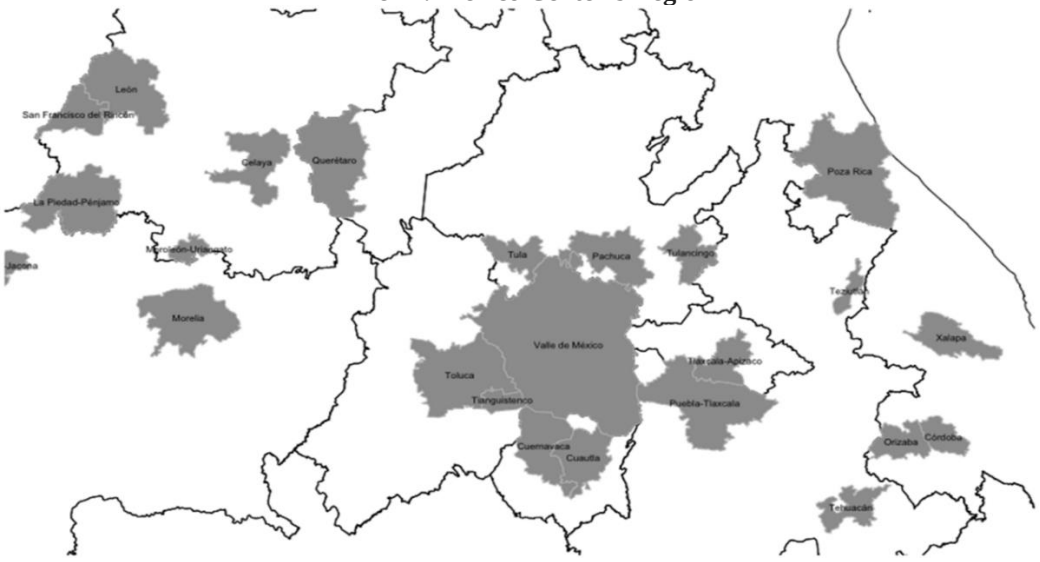
Kumbhakar, S.C., Wang, H.-J., & Horncastle, A.P. (2015). *A practitioner´s guide to sthochastic frontier analysis using stata*. Cambridge: Cambridge University Press.

Landry, C. (2008). *The Creative City: A Toolkit for Urban Innovators.* Routledge: London.
Miles, I., & Green, L. (2008). Hidden innovation in the Creative Industries. NESTA Research Report, London.
Müller, K., & Rammer, C. (2009). The role of creative industries in industrial innovation. *Innovation: Management, Policy & Practice*, 146-168.
Montanari F., Scapolan A., Mizzau L. (2018). Embeddedness and Locational Choices: A Study of Creative Workers in a Dance Organisation. *Urban Studies*, 55(5), 1121–38.
Nathan, M., Kemeny, T., Pratt, A., & Spenser, G. (2016). *Creative economy employment in the US, Canada and the UK: a comparative analysis*. London, U.K.: NESTA.
Nordhaus, W. D. (2003). The sources of the productivity revival in the 1990s: Specialization, investment, and productivity growth. *The Quarterly Journal of Economics*, 118(2), 817-861.
O'Connor, J. (2010). The cultural and creative industries. In *The Routledge Research Companion to Planning and Culture* (pp. 171-184). Routledge.
OECD (2018). *Compendium of Productivity Indicators 2018*. OECD.
ONU-Habitat (2019). *Índice de las ciudades prósperas.* México: CPI.
Potts, J. (2007). How creative are the super-rich? *Agenda-A Journal of Policy Analysis and Reform*, 13(4), 339-350.
Pourzakarya, M., & Fadaei Nezhad Bahramjerdi, S. (2023). Reviewing the role of cultural and creative industries in developing an urban cultural policy platform in Rasht city, Iran. *Journal of Place Management and Development*, 16(2), 145-162.
Pratt, A. C. (2008). Creative cities: The cultural industries and the creative class. *Geografiska Annaler: Series B, Human Geography*, 90(2), 107-117.
Pratt, A. C. (2011). The Cultural Contradictions of the Creative City. *City, Culture and Society*, 2(3), 123-130. https://doi.org/10.1016/j.ccs.2011.07.002
Rodríguez-Insuasti, H., Montalván-Burbano, N., Suárez-Rodríguez, O., Yonfá-Medranda, M., & Parrales-Guerrero, K. (2022). Creative economy: A worldwide research in business, management and accounting. *Sustainability*, 14(23), 16010.
Rodriguez-Insuasti, H., Leon, M., Montalván-Burbano, N., & Parrales-Guerrero, K. (2022, December). Mapping the Research in Orange Economy: A Bibliometric Analysis. In *International Conference on Innovations in Bio-Inspired Computing and Applications* (pp. 778-795). Cham: Springer Nature Switzerland.
Solow, R. (1957). Technical change and the aggregate production funtion. *Review of Economics and Statistics*, 39(3), 312-320.
Stevenson, D. (2006). The Arts and Entertainment: Situating Leisure in the Creative. In *Handbook of Leisure Studies* (pp. 354-362). Palgrave.
Strazdas, R., Cemeviciute, J., & Jancoras, Z. (2014). Dynamics of the Understanding of Innovation in the Context of the Development of Traditional and Creative Industries. *Transformations in Business & Economics*, 13, 377-395.
Swords, J., & Prescott, R. (2023). Creative industries spatial policy in the United Kingdom, 1995–present. *Local Economy*, 38(2), 177-186.
Throsby, D. (2008). The concentric circles model of the cultural industries. *Cultural Trends*, 17(3), 37-41.
Towse, R., & Hernández, T. N. (Eds.). (2020). *Handbook of cultural economics.* Edward Elgar Publishing.
UNCTAD (2008). *Creative Economy*. United Nations.
UNESCO (2005). Informe sobre la economía creativa. Naciones Unidas para la Educación, la Ciencia y la Cultura. UNESCO, París, Francia.
Valdivia, M., Quintana-Romero, L., Mendoza-González, MÁ. & Rodríguez, L. (2020). Economía creativa en las ciudades de México: un estudio sobre la presencia y vinculaciones de las industrias-ocupaciones creativas y culturales en el sistema urbano de México. CRIM, UNAM. Retrieved from: https://libros.crim.unam.mx/index.php/lc/catalog/view/20/12/111-1

Annex 1: Mexican Cities

Source: Author's elaboration based on CONAPO (2010)

Annex 2: Mexico Center´s Region



Source: Author's elaboration based on CONAPO (2010)

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4. Os artigos submetidos à Direção Editorial para publicação serão sempre avaliados (anonimamente) por dois especialistas na área, convidados para o efeito pela Direção Editorial. Os dois avaliadores farão os comentários que entenderem ao artigo e classificá-lo-ão de acordo com critérios definidos pela Direção Editorial. Os critérios de avaliação procurarão refletir a originalidade, a consistência, a legibilidade e a correção formal do artigo. No prazo máximo de 16 semanas após a submissão do artigo, os seus autores serão contactados pela Direção Editorial, sendo-lhes comunicado o resultado da avaliação feita.

O processo de avaliação tem três desenlaces possíveis:

(1) O artigo é admitido para publicação tal como está (ou com meras alterações de pormenor) e é inserido no plano editorial da revista. Neste caso, a data previsível de publicação será de imediato comunicada aos autores.

(2) O artigo é considerado aceitável mas sob condição de serem efetuadas alterações significativas na sua forma ou nos seus conteúdos. Neste caso, os autores disporão de um máximo de 6 semanas para, se quiserem, procederem aos ajustamentos propostos e para voltarem a submeter o artigo, iniciando-se, após a receção da versão corrigida, um novo processo de avaliação.

(3) O artigo é recusado.

5. A RPER poderá organizar números especiais de natureza temática, na sequência de conferências, *workshops* ou outros eventos relevantes na sua área de interesse. Embora nestes casos o processo de avaliação dos artigos possa ser simplificado, a RPER manterá ainda assim, escrupulosamente, o princípio de revisão pelos pares de todos os artigos.

6. Excecionalmente a RPER poderá contudo publicar artigos "por convite", ou seja não sujeitos ao crivo de revisores. A singularidade destes artigos será sempre assinalada, de forma transparente, na sua primeira página.

7. A RPER reconhece o direito dos membros da sua Direção Editorial (incluindo o seu Diretor) a submeterem artigos para publicação. Sempre que um membro da Direção Editorial é autor ou coautor de um artigo, então é necessariamente excluído do processo de revisão, em todos os seus passos, incluindo a decisão final.

8. A RPER reconhece o direito de recurso de qualquer sua decisão relativa à aceitação de um artigo para publicação. Esse recurso é endereçado ao Diretor que deverá informar toda a Direção Editorial. Os termos do recurso serão enviados aos revisores, que terão um prazo máximo de 30 dias para se

pronunciarem em definitivo. No caso de não haver acordo entre os dois *referees*, a Direção Editorial tem obrigatoriamente de indicar um terceiro especialista. Não existe novo recurso, para uma segunda decisão que decorra deste processo.

9. A RPER encoraja a publicação de críticas relevantes, por outros autores, a artigos publicados nas suas páginas. Os autores criticados têm sempre a possibilidade de resposta.

10. Os *referees* estão sujeitos ao dever de confidencialidade, quer quanto ao conteúdo dos artigos que apreciam, quer quantos aos seus próprios comentários, devendo mais em geral garantir que todo o material que lhes é submetido é tratado em confiança. Será sempre enviada aos revisores a informação sobre os princípios do Código de Conduta referido em 1.

11. Uma vez o artigo aceite, e feito o trabalho de formatação gráfica prévio à sua publicação na revista, serão enviadas ao autor as respetivas provas tipográficas para revisão. As eventuais correções que este quiser fazer terão de ser devolvidas à Direção Editorial no prazo máximo de 5 dias úteis a contar da data da sua receção. Só serão aceites correções de forma.

12. Ao autor e a cada um dos coautores de cada artigo aceite será oferecido um exemplar do número da Revista em que o artigo foi publicado.

13. Os originais, depois de formatados de acordo com as presentes normas, não poderão exceder as 30 páginas, incluindo a página de título, a página de resumo, as notas, os quadros, gráficos e mapas e as referências bibliográficas.

14. As propostas de artigo deverão ser en-viadas por e-mail para rper.geral@gmail.com, ou pelo correio, para o Secretariado da RPER: APDR - Universidade dos Açores, Rua Capitão João d'Ávila 9700-042 Angra do Heroísmo – PORTUGAL. Para comunicação posterior o contacto com o Secretariado far-se-á pelo: e-mail: rper.geral@gmail.com.

B. Normas respeitantes à estrutura dos artigos

1. Os autores deverão enviar o artigo completo (conforme os pontos seguintes), por e-mail ou em CD-rom, para o os contactos referidos no ponto 14 das Normas A.

2. Os textos deverão ser processados em Microsoft Word for Windows (versão 97 ou posterior). O texto deverá ser integralmente a preto e branco.

3. Na publicação os gráficos, mapas, diagramas, etc. serão designados por "figuras" e as tabelas por "quadros".

4. As eventuais figuras e quadros deverão ser disponibilizados de duas formas distintas: por um lado devem ser colocados no texto, com o aspeto pretendido pelos autores. Para além disso, deverão ser disponibilizados em ficheiros separados: os quadros, tabelas e gráficos serão entregues em Microsoft Excel for Windows, versão 97 ou posterior (no caso dos gráficos deverá ser enviado tanto o gráfico final como toda a série de dados que lhe está na origem, de preferência no mesmo ficheiro e um por worksheet); para os mapas deverá usar-se um formato vetorial em Corel Draw (versão 9 ou posterior).

5. As expressões matemáticas deverão ser tão simples quanto possível. Serão apresentadas numa linha (entre duas marcas de parágrafo) e numeradas sequencialmente na margem direita com numeração entre parêntesis curvos. A aplicação para a construção das expressões deverá ser ou o Equation Editor (Microsoft) ou o MathType.

6. Salvo casos excecionais, que exigem justificação adequada a submeter à Direção Editorial, o número máximo de coautores das propostas de artigo é quatro. Só deverão ser considerados autores os que contribuíram direta e efetivamente para a pesquisa refletida no trabalho.

7. O texto deve ser processado em página A4, com utilização do tipo de letra Times New Roman 12, a um espaço e meio, com um espaço após parágrafo de 6 pt. As margens superior, inferior, esquerda e direita devem ter 2,5 cm.

8. A primeira página conterá exclusivamente o título do artigo, em português e em inglês, bem como o nome, morada, telefone, fax e e-mail do autor, com indicação das funções exercidas e da instituição a que pertence. No caso de vários autores deverá aí indicar-se qual o contacto para toda a correspondência da Revista. Deve ser também incluída na primeira página uma nota sobre as instituições financiadoras da investigação que conduziu ao artigo. Este nota é obrigatória quando pertinente.

9. A segunda página conterá unicamente o título e dois resumos do artigo, um em português e outro inglês, com um máximo de 800 caracteres cada, seguidos de um parágrafo com indicação, em português e inglês, de palavras-chave até ao limite de 5, e ainda 2 a 5 códigos do Journal of Economic Literature (JEL) apropriados à temática do artigo, a 3 dígitos, como por exemplo R11. Os títulos, os resumos, as palavras-chave e os códigos JEL são obrigatórios.

10. Na terceira página começará o texto do artigo, sendo as suas eventuais secções ou capítulos numerados sequencialmente utilizando apenas algarismos (não deverão utilizar-se nem letras nem numeração romana).

11. Cada uma das figuras e quadros deverá conter uma indicação clara da fonte e ser, tanto quanto possível, compreensível sem ser necessário recorrer ao texto. Todos deverão ter um título e, se aplicável, uma legenda descritiva.

12. A forma final das figuras e quadros será da responsabilidade da Direção Editorial que procederá, sempre que necessário, aos ajustamentos necessários.

C. Normas respeitantes às referências bibliográficas

1. A "Bibliografia" a apresentar no final de cada artigo deverá conter exclusivamente as citações e referências bibliográficas efetivamente feitas no texto.

2. Para garantir o anonimato dos artigos, o número máximo de citações de obras do autor do artigo (ou de cada um dos seus coautores) é três e não são permitidas expressões que possam denunciar a autoria tais como, por exemplo, "conforme afirmámos em trabalhos anteriores (cfr. Silva (1998:3))".

3. O estrito cumprimento das normas à frente só é obrigatório na versão final dos artigos, após aceitação. Ainda assim, recomenda-se fortemente a sua adoção em todas as versões submetidas.

4. Os autores citados ao longo do texto serão indicados pelo apelido seguido, entre parêntesis curvos, do ano da publicação, de ":" e da(s) página(s) em que se encontra a citação. Por exemplo: ao citar-se "Silva (2003: 390-93)": está-se a referir a obra escrita em 2003 pelo autor "Silva", nas páginas 390 a 393. Deverá usar-se "Silva (2003: 390-93)" e não "SILVA (2003: 390-93)". No caso de uma mera referenciação do autor bastará indicar "Silva (2003)".

5. No caso de o mesmo autor ter mais de um trabalho do mesmo ano citado no artigo, indicar-se-á a ordem da citação, por exemplo: Silva (2003a: 240) e Silva (2003b: 232).

6. As referências bibliográficas serão listadas por ordem alfabética dos apelidos dos respetivos autores no fim do manuscrito. O nome será seguido do ano da obra entre parêntesis, e da descrição conforme com a seguinte regra geral:

Monografias: Silva, Hermenegildo (2007a), *A Teoria dos Legumes*, Coimbra, Editora Agrícola

Coletâneas: Sousa, João (2002), "Herbicidas e estrumes" in Cunha, Maria (coord.), *Teoria e Prática Hortícola*, Lisboa, Quintal Editora, pp. 222-244

Artigos de Revista: Martins, Vicente (2009), "Leguminosas Gostosas", *Revista Agrícola*, Vol. 32, nº 3, pp. 234-275

7. A forma final das referências biblio-gráficas será da responsabilidade da Direção Editorial que procederá, sempre que necessário, aos ajustamentos necessários.

NORMS FOR THE SUBMISSION OF PAPERS TO THE PORTUGUESE REVIEW OF REGIONAL STUDIES

A. Norms concerning papers submission and evaluation

1. Although the Portuguese Review of Regional Studies (RPER) is not a member of the Committee on Publication Ethics (COPE), its Editorial Board decided to adhere to the principles of the COPE Code of Conduct, from Ja-nuary 1st 2012 onwards:
(http://publicationethics.org/files/Code%20of%20conduct%20for%20journal%20editors4.
pdf).

2. In principle, only papers that have never been published (in another journal or book, including conference Proceedings) can be consi-dered for publication in RPER. The previous publication in a series of "working papers" (electronic or paper format) is an exception to this rule. The Editorial Board may agree with other sporadic exceptions, when copyrights are secured.

3. When a paper is submitted to RPER, authors must explicitly state that it will not be submitted for publication in any other journal or book until the reviewing process is completed. For this purpose, a signed declaration must be sent along with the paper. If the paper is rejected by the Editorial Board, the authors are free to publish it anywhere else.

4. Papers submitted for publication will always be reviewed (anonymously) by two experts in the area, invited by the Editorial Board. Both referees will offer their comments and classify it in accordance with the criteria defined by the Editorial Board. The reviewing criteria include originality, consistency, readability and the paper's formal correction. The authors will be informed by the Editorial Board of the results of the evaluation within 16 weeks of its receipt. The assessment has three possible outcomes:

(1) The paper is accepted for publication just as it is (or with minor changes) and it is included in the editorial plan. In this case, the authors are immediately informed of the expected publication date.

(2) The paper is considered acceptable provided that major changes are made to its form

or contents. In this case, authors will have a maximum of six weeks to make such changes and to submit the paper again. Once the revised version is received, a new assessment process starts.

(3) The paper is refused.

5. RPER may organize special issues on specific themes, following conferences, workshops, or other events relevant in its area of interest. Although, in these cases, a simplifying shorter reviewing process may be adopted, the principle of peer-review selection will always be preserved.

6. Exceptionally, RPER may publish articles "by invitation", meaning that they are not subject to the reviewing process. These outstanding articles, however, are always clearly signaled as such in their front page.

7. RPER acknowledges the right of the members of its Editorial Board (including its Director) to submit papers to the journal. When an author or co-author is also a member of the Editorial Board, he/she is excluded from the reviewing process in all its stages, including the final decision.

8. RPER acknowledges the authors' right of appeal on any publishing decision of the Editorial Board. That appeal is made to the Director of RPER that will inform the Editorial Board. The new arguments will be sent to the reviewers, asking for a final judgment within a 30-day term. In case of disagreement between the two referees, the Editorial Board is compelled to appoint a third reviewer. There is no further appeal for a second decision ensuing this process.

9. RPER positively welcomes cogent criticism on the works it publishes. Authors of criticized material will have the opportunity to res-pond.

10. Reviewers are required to preserve the confidentiality on the contents of the papers and on their comments, and requested, more gene-rally, to handle all the submitted material in confidence. Proper information on the principles of the Code of Conduct referred in 1. will always be provided to the reviewers.

11. Once the paper has been accepted and formatted for publishing, it will be sent to the author for graphics checking and revision. Any corrections the author might want to make must be sent to RPER within five days. Only formal corrections will be accepted.

12. Each author and co-author of accepted papers will be offered a number of the published issue

13. Articles cannot exceed 30 pages after being formatted according to the present norms, including the title page, the summary page, notes, tables, graphics, maps and references.

14. Papers must be sent, by e-mail to rper.geral@gmail.com or by normal mail, to the Secretariat of RPER: APDR - Universidade dos Açores, Rua Capitão João d'Ávila, 9700-042 Angra do Heroísmo – PORTUGAL. For future contact please use the e-mail address: rper.geral@gmail.com.

B. Norms concerning papers structure

1. The authors must send a complete version of the paper by e-mail or on a CD-Rom by mail, in the original Microsoft Word file, to the contacts specified in point 14 of Norms (A).

2. Texts must be processed in Microsoft Word for Windows (97 or later version). All written text must be black.

3. Graphics, maps, diagrams, etc. shall be referred to as "Figures" and tables shall be referred to as "Tables".

4. Figures and Tables must be delivered in two different forms: inserted in the text, accor-ding to the author's choice, and in a separate file. Tables and graphics must be delivered in Microsoft Excel for Windows 97 or later. Graphics must be sent in both the final form and accompanied by the original data, preferably in the same file (each graphic in a different worksheet). Maps must be sent in a vector format, like Corel Draw or Windows Metafile Applications.

5. Mathematical expressions must be as simple as possible. They will be presented on one line (be-tween two paragraph marks) and numbered sequentially at the right margin, with numeration inside round brackets. Equation Editor (Microsoft) or Math Type are the accepted Applications for original format files.

6. The paper must have no more than four co-authors. Exceptions may be accepted when a reason-able explanation is presented to the Editorial Board. Authorship must be limited to actual and direct contributors to the conducted research.

7. Text must be processed in A4 format, Times New Roman font, size 12, line space 1.5 and 6 pt space between paragraphs. The upper, lower, left and right margins must be set to 2.5 cm.

8. The first page shall contain only the paper's title, the author's name, address, phone and fax numbers and e-mail, and the author's affiliation. In the case of several authors, please indicate the contact person for correspondence. A remark on funding institutions of the research or related work leading to the article – that is compulsory when it applies – must be placed as well in this first page.

9. Second page shall contain the title and the abstract of the paper, in English and, if possible, in Portuguese as well, with no more than 800 characters, followed by two lines, one with the keywords to a limit of 5, and the other with the proper Journal of Economic Literature (JEL) codes describing the paper. JEL codes must be from 2 up to 5, with three digits, as for example R11. The title, the abstract, the key-words and the JEL codes area all compulsory, at least in English.

10. Text starts on the third page. Sections or chapters are numbered sequentially using Arabic numbers only (letters or Roman numeration must not be used).

11. Figures and Tables must contain a clear source reference. These shall be as clear as possible. Each must have a title and, if applicable, a legend.

12. The final format of Figures and Tables will be of the responsibility of the Editorial Board, who will allow some adjustments, whenever necessary.

C. Norms concerning bibliographic references

1. The references listed at the end of each paper shall only contain citations and references actually mentioned in the text.

2. To ensure the anonymity of papers, each author's self references are limited to three and no expressions that might betray the authorship are allowed (for example, "as we affirmed in previous works (cfr. Silva (1998:3)").

3. Although their meeting in preliminary versions is recommendable, the bibliographic norms below are mandatory for the final (accepted) version only.

4. Authors cited in the text must be indicated by his/her surname followed, within round brackets, by year of publication, by ":" and by the relevant page number(s). For example, the citation "Silva (2003: 390-93)", refers to the work written in 2003 by the author Silva, on pages 390 to 393. If the author is merely mentioned, indication of "Silva (2003)" is sufficient.

5. In case an author has more than one work from the same year cited in the paper, citation must be ordered. For example: Silva (2003a: 240) and Silva (2003b: 232).

6. References must be listed alphabetically by authors' surnames, at the end of the manus-cript. The name will be followed by year of pu-blication inside round brackets and the description, thus:

Monographs: Silva, Hermenegildo (2007a), *The Vegetables Theory*, Cambridge, Agriculture Press

Collection: Sousa, João (2002), "Weed Ki-llers and Manure" in Cunha, Maria (coord.), *Farming - Theories and Practices*, London, Grassland Publishing Company, pp. 222-244

Journal Papers: Martins, Vicente (2009), Tasty Broccoli, *Farmer Review*, Vol. 32, nº 3, pp. 234-275

7. The final format of the references will be the responsibility of the Editorial Board, who will allow adjustments whenever necessary.

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