

Article

## Unveiling the impact of European Structural Funds for innovation in Andalusia, Spain

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**Abstract.** This study evaluates the impact of European Union Structural Funds for innovation on key business indicators related to growth, profitability, and innovation at the regional level. We use the case of Andalusia during the period 2007-2020, a Spanish region benefiting from these funds, focusing on the ERDF-Innterconnecta program which supports business collaboration in R&D projects. While some indicators, showed improvement, others did not. By analyzing these mixed results, we aim to inform the planning, design, and implementation of future regional innovation policies.

**Keywords:** policy evaluation; business innovation policies; structural funds; business performance; employment; regional development.

**JEL classification:** O32; O38; O12; L25

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### 1. Introduction

While the Great Recession was spreading across the planet thanks to financial globalization and the limitations of the global financial system, the Convergence Objective regions of the European Union (EU), such as Andalusia, saw the exit from austerity of the crisis pushed towards a progressive reduction in the budget allocation of the European Structural Investment Funds (ESIF) (Sande, 2020; 2018). When the crisis broke out, the EU had just approved a program called the Technology Fund aimed at promoting business research, development and innovation (R&D&I) in the period 2007-2013. This program, which was endowed with more than 2,000 million euros, continued in the period 2014-2020 with the well-known Smart Growth Program (SGP). While it is true that companies play a crucial role within the National (Sánchez, Martínez, & Arellano, 2018) and Regional Innovation Systems (NIS/RIS) (Karlsen, 2013), and that the business fabric tends to be more fragile in the territories of the Convergence Objective as a consequence of the low interaction with other agents, it is also true that the small size of companies and their productive specialization in low technological intensity sectors (Hollanders et al., 2014; 2016; 2019) hinder the ability to

absorption of resources (Sande, 2020; Sande & Vence, 2021). However, the nature and objective of these funds caused them to be directed mainly at the business fabric and not at the systemic configuration (Sande & Vence, 2019; Cooke, Uranga & Etxebarria, 1998; León & Fernández, 2006; Nikitskaya et al., 2014), with the consequences derived from this policy choice.

Considering the previous starting point, the analysis of the results of the Innterconnecta program has been selected as the objective of this original study since this has been the main technological policy aimed at supporting companies in a peripheral region such as Andalusia. Within this framework, this research aims to evaluate whether the resources and projects financed by the Structural Funds have had a positive impact on the growth, economic performance, and innovation of Andalusian companies. The originality of this work consists of addressing the study of the impact of ESIF from the microeconomic level, as opposed to the usual macroeconomic approaches. Furthermore, it is the first impact study of innovation programs at the Andalusian (peripheral region) level that examines the results of this policy according to the set of selected indicators. The importance of the choice of the analyzed indicators is motivated by the fact that they reflect some of the main characteristics of the companies in the territory that could be promoted through the public policies implemented in the region. In this way, the results extracted will allow for the generation of knowledge to improve the planning, design, and application of European policies for regional innovation in the territory.

The article is structured as follows: the second section reviews the importance of innovation policies, as well as the promotion of business development in peripheral and technologically backward territories. It also includes a description of the policies analyzed; the third section describes the methodology used and the main data sources; the fourth section analyses the results of the program and assesses the impact on the main business indicators; finally, the fifth section sets out the conclusions drawn from the analysis carried out and makes recommendations for the future planning of innovation policies in the autonomous region.

## **2. Literature review**

The first part of this section reviews the importance of European policies at the regional level, focusing on the impact of the Structural Funds for innovation on the business fabric. The programs under study are described below.

### **2.1 European policies and the regional level: impact of the Structural Funds for innovation on the business fabric**

The ESIF has been one of the EU's main funding instruments, aimed at trying to reduce economic disparities between regions and Member States. Despite the existence of studies that have questioned the ability of the ESIF to reduce European regional inequalities over time (Rodríguez-Pose, 2000; Rodríguez-Pose & Fratesi, 2004; Ederveen, de Groot & Nahuis, 2006; van Der Zwet et al., 2017; Neagu et al., 2017; Di Caro & Fratesi, 2021), other research has shown its contribution to economic cohesion in Europe (Caldas, Dollery & Marques, 2018; López-Villuendas & del Campo,

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2022; Maynou et al., 2014) and in Spain, highlighting the role played in the growth of Objective 1 regions (Cancelo, Fafña & López-Rodríguez, 2005; Sosvilla-Rivero, Bajo & Díaz, 2003; De la Fuente, 2003). However, some authors (Lembcke & Menon, 2017) insist on the criticism that regional inequalities persist over the years and, in some cases, even increase. Indeed, for others, the results of cohesion policy do not seem very robust (Krieger-Boden, 2018).

The main feature that defines the results provided by the academic literature on the impact of European policies at the regional level is the disparity of conclusions obtained in the different studies. Thus, while some authors (Bernini & Pelegrini, 2011; Vivarelli, 2014) find that subsidized companies improve their production indicators compared to non-subsidized companies, for Sande (2022b) and Vojtovič (2016) companies financed by ESIF do not achieve economic results that contribute to their growth in these indicators. For others (Breidenbach, Mitze & Schmidt, 2019), negative funding effects on the business fabric significantly correlate with lower levels of regional institutional quality.

According to Sande (2020), part of the inefficiencies in the application of European structural resources earmarked for areas such as innovation in Objective 1 regions could be due to factors such as the lack of systemic vertebration at regional level, the lack of alignment with industrial policies and even the existence of leakage of resources towards more advanced and central regions. In the same vein, Gancarczyk et al. (2022) argue that the co-evolutionary theoretical framework focuses on the so-called interaction mechanisms (IM), meaning the processes underlying industrial policy that allow for a better understanding of policy roles and industrial development paths. In this context, innovation policies would be understood as a proactive complement to the need for structural industrial change.

Regarding the impact of Structural Funds for innovation on firms, studies have shown different results. For example, Bachtrögler & Hammer (2018) have used techniques such as *Propensity Score Matching* (PSM), with which they have found different effects of the Structural and Cohesion Funds for six European countries. In general, according to the authors, firms tend to hire more workers and increase their capital stock. Other studies, such as those carried out by Sande (2022a), have even shown differences in the impact of the ESIF in Objective 1 regions depending on the size of the recipient firms. Furthermore, Baláž, Jeck & Balog (2023) point to the importance of spatial proximity and personal contacts to achieve better innovation results. In summary, some policies have positive impacts on key measures, whereas others do not (OECD, 2023). In a research conducted by Dvouletý, Srhoj & Pantea (2021), the findings show mostly the positive outcomes of the grants on firm survival, employment, tangible/fixed assets, sales/turnover, with mixed findings for labour productivity and total factor productivity (TFP). However, we point out that there are significant differences concerning the time period of analysis (investigating short-term vs long-term outcomes) and, importantly, the heterogeneity of effects concerning firm size and age, region, industry and intensity of support.

When talking about the impact of ESIF on business results, again, the main feature that defines the results provided by the academic literature is the disparity of conclusions obtained in the different studies. While some studies (Hartsenko & Sauga, 2012; Arbidane & Tarasova, 2018) find that activities financed by the ESIF would increase the competitiveness of firms and business activity in general, for others there is generally no impact of structural resources on business

performance and productivity (Sande, 2022b; Dumciuviene, Stundziene & Startiene, 2015; Vojtovičj, 2016; Bachtrögler & Hammer, 2018). Other authors (Lucaciu, 2018) highlight the positive effect of complementarity of the different funds. This is a fact that cannot be dissociated from the results defended by Milio (2007), who asserts that the effects of resources would be linked to the existence of administrative capacity to implement the funds.

Related exclusively to the impact on a very important indicator such as employment, the literature has traditionally argued that technological development and innovation can help solve socio-economic problems and foster employment (Cozzens et al., 2007; Alzugaray, Medores & Sutz, 2012; Florio & Moretti, 2014). But the truth is that the implementation of policies aimed at technological development and innovation has sometimes implied social inequalities and greater inequalities in the labour market (Lee & Rodríguez-Pose, 2013). So much so that, according to several studies, there is no positive impact of subsidies on business employment (Bernini & Pelegrini, 2011; Bondonio, 2014; Bachtrögler & Hammer, 2018; Sande, 2022b), and sometimes the Funds are even used to solve other financial problems of companies (Komninou, Musyck & Iain Reid, 2014; Sergej, 2016). However, Cerqua and Pellegrini (2014) found that the impact of subsidies on employment, investment, and turnover is positive and statistically significant, while the effect on productivity is mostly negligible. Nevertheless, Nemethova, Siranova & Sipikal (2019) found a positive and significant impact on labour productivity that disappears shortly after 1 year following subsidy allocation.

Research results have shown that innovation policies must be tailored to the characteristics of territories (Tödting & Trippl, 2005; Foray & Van Ark, 2007; McCann & Ortega-Angilés, 2013; Sande, 2020). For this reason, the EU and regional governments have not implemented innovation policies in line with the needs of NIS and their enterprises in the design of innovation policies. In this context, regions that need to improve their technological capacities - classified as Objective 1 regions in the 2000-2006 programming period and Convergence regions from 2007-2013-, need to design strategies appropriate to their situation (Heijs, 2001; Pastor et al., 2010). In the Spanish case, Andalusia, Galicia, Extremadura and Castilla-La-Mancha maintained this situation.

Support through the ESIF for the financing of technological innovation has shown mixed results over time. Thus, while some studies have found positive results of technological innovation policies for the business fabric (Musyck & Reid, 2007; Croce, Martí & Murtinu, 2013; Bronzini & Piselli, 2016; Le & Jaffe, 2017; Segarra-Blasco, 2018), other studies reflect moderate results of direct public funding in peripheral contexts (Sande & Vence, 2021; Sande, 2022a; Sande & Sande, 2023), or even lack of results for certain contexts and indicators (Clausen, 2009; Blasio, Fantino & Pellegrini, 2015; Lewandowska, Stopa & Humenny, 2015). In this sense, Mieszkowski & Barbero (2021) explain less-than-adequate conditions in rural areas and smaller counties, which may limit the potential for attraction and implementation of ESIF.

In order to find out the results of the ESIF on business innovation -and particularly the results on growth, performance and innovation of companies in the medium term-, this analysis presents the data from an instrument such as the *Innterconecta* programme, firstly belonging to the TF and then to the SGP, which has been applied for almost a decade in a peripheral and moderately innovative Autonomous Community such as Andalusia.

## 2.2 The policies object of study

The European Council approved the birth of the TF as a program dedicated to the promotion of business R&D&I (Ministerio de Economía y Hacienda, 2007). This TF had a continuity framework for business innovation after the approval of the SGP (Ministerio de Hacienda y Administraciones Públicas, 2014). Table 1 shows the main descriptive data on this funding, including territorial allocation, objectives, and eligible actions.

**Table 1.** Descriptive data on the Technology Fund (TF) and the Smart Growth Program (SGP)

	<b>TECHNOLOGY FUND</b>	<b>SMART GROWTH</b>
Assignment to Spain	2.248,45 M€	+ 3.939,18 M€
Assignment to Andalusia	976,80 M€	1.612 M€*
Territorial distribution Funds	-70% for Obj. Convergence regions (Galicia, Andalusia, Extremadura and Castilla La Mancha) -15% for Phasing-in regions (growth effect) -10% for Competitiveness Objective regions -5% for Phasing-out regions (statistical effect)	-Plurirregional
Objectives	-To articulate and integrate the Spanish R&D&I system with the regional innovation systems -Promote business innovation, especially in SMEs in Convergence Objective regions -To support the transfer of research results to companies -Widen the base of the Science, Technology and Enterprises System (STES) by attracting SMEs to R&D&I -Promote gender equality in R&D&I	-Promoting R&D and innovation -Improving the use, quality and access to Information and Communication Technologies (ICT). -Improve the communication and competitiveness of SMEs.
Subsidied actions	-To vertebrate the innovation system, incorporating SMEs into innovative activity. -To create and consolidate Technology and Research Centres oriented towards relations with companies. -Promote the transfer of research from PRIs to companies. -Attract SMEs and other agents to innovation and research activity.	-Capacity building for the development of R&D&I activities supported by competitive scientific infrastructures at European and international level. -Stimulating and fostering capacities for the implementation of business R&D&I projects. -Promoting the incorporation of researchers and R&D&I personnel and fostering mobility between public sector personnel and the business fabric, as well as the creation of high added value employment.

**Source:** Own elaboration. **\*Note:** Total forecast expenditure (Boscá et al., 2016).

**Table 2.** ERDF-Innterconecta Programme: descriptive data.

	<b>TECHNOLOGY FUND</b>	<b>SMART GROWTH</b>
<b>Assignment to Spain</b>	262 M€	210 M€
<b>Territorial distribution</b>	-Andalusia 150 M€ -Galicia: 105 M€ -Extremadura: 7 M€ -Castilla La Mancha: The region does not participate in these call for proposals	-Plurirregional
<b>Subsidised areas</b>	-All, as long as they stimulate employment and increase added value (Ministerio de Economía y Competitividad, 2013)	Health, demographic change and well-being, food safety and quality; safe, efficient and clean energy, smart, sustainable and integrated transport; action on climate change; social change and innovations, digital economy and society; security, safety and defence
<b>Dimension and Amounts subsidized in the projects (Andalusia)</b>	Up to 5 M€	Between 1-4 M€
<b>Project requirements</b>	Formation of an Economic Interest Grouping (EIG) or Consortium	
<b>Project duration</b>	Two and three-year projects (Ministerio de Ciencia e Innovación, 2012).	
<b>Objectives</b>	Support for large R&D projects Increasing business R&D expenditure Use of existing infrastructures Mobilisation of SMEs Greater involvement of stakeholders and promotion of innovative culture Internationalisation of innovation Experimental development and cooperation between companies	

The European and Regional Development Fund-*Innterconecta* (ERDF-*Interconecta*) calls arose in the middle of the 2007-2013 programming period, in view of the low implementation that was being achieved by the TF. The birth of this programme was based on the premise of supporting integrated experimental development projects of a public-private nature, of a strategic nature, large in size and aimed at developing new technologies in technological areas with international economic projection. The aid granted until 2020 under this programme financed projects with no thematic limitation, on the condition that they fostered employment, were of a high technological level, and promoted activities that favoured an increase in the added value of the participating companies (Ministerio de Economía y Competitividad, 2013). The basic information on the *Innterconecta* programme is broken down in Table 2.

### 3. Methodology and data sources

Throughout this section, the information is divided into two sub-sections. The first sub-section explains the methodology used and the limitations of the work, while the second describes the data sources and the main data used in the current research.

## 3.1 Methodology

This paper proposes a microeconomic analysis with a strong empirical character. The qualitative and quantitative analysis of the data generated for the ERDF-*Innterconecta* calls in Andalusia has been used, in addition to the data corresponding to the Autonomous Community in the case of multi-regional calls.

We used the *Propensity Score Matching* (PSM) methodology for the statistical analysis, which analyses the covariances between two groups of values: on the one hand, the companies not participating in the policy and, on the other, the participating companies. We performed the statistical test, for which the number of companies in the control sample with data for the indicators was 355, while for those participating in *Innterconecta* it was 337. For each of the indicators, these values may vary due to the occasional lack of data for some entities, which discourages the statistical study from being disaggregated by CNAE groups. For both the control sample and the participating companies, we first calculate the number for which matching has taken place. The mean of the values ( $\bar{x}$ ) and the standard deviation ( $\sigma$ ) are then studied. In case the value of the standardised mean difference (or SMD), measured through the *d-index*, is greater than 0.1, imbalance would be observed and we should apply the PSM, however, in order to provide a broader information of the results, we have chosen to also calculate the PSM for those values whose *d-index* was less than 0.1. The propensity score was then estimated by applying a *logit* model in which the outcome variable is a binary variable indicating whether the policy was implemented or not, using the R software package *MatchIt*. Among the different methods to perform the *matching* (*exact matching, nearest neighbour, optimal matching, full matching and caliper matching,...*), we selected the *nearest neighbour*, as we considered it more appropriate to match each individual in the treatment group with the individual in the control group that has the closest *propensity score*. Using one-by-one nearest neighbour PS matching =N(1)1C, one treated unit  $i \in T$  is matched to one control unit  $j \in C$ . That is, that individual is selected from the candidates pairing whose propensity score is the most similar to the propensity score of the individual to be paired in the case group. There is a one-to-one matching, in the former an element of the control group is used more than once. The values of the variables have been taken at the end of the period, as a result for these indicators. Once the test is completed, we include the *p-value*, which indicates whether there are significant differences between the group that participates in the policy and the group that does not.

Nevertheless, the proposed impact measurement study has had to face some problems and limitations. Firstly, there is the problem of self-selection, arising from the companies' ability to choose whether or not to participate in the calls for proposals of the program under analysis. Secondly, the problem of endogeneity has been addressed, insofar as the decision of public administrations when approving the program has been an external trigger that has allowed firms to participate (García-Nicolás & Cantos, 2015; Lago & Martínez, 2004). Finally, the results could have distorting biases in case there were governmental interests in the selection of funding to projects and companies (Martí, 2020). To isolate the effect of these problems, the use of the *Propensity Score Matching* statistical technique has been proposed, which, by accounting for and analyzing covariances, allows the effect of a policy to be estimated.

### 3.2. Data sources and main data

This paper proposes a microeconomic analysis with a strong empirical character. The qualitative and quantitative analysis of the data generated for the ERDF-*Innterconecta* calls in Andalusia has been used, in addition to the data corresponding to the Autonomous Community in the case of multi-regional calls.

The data used have been extracted from various sources, including the Spanish Ministry of Finance, the Ministry of Economy, Finance and European Funds of the Andalusian Regional Government, the Spanish National Statistics Institute (INE), and official journals of the administrations, which have enabled an understanding of the current situation in Andalusia. However, the Centre for Technological and Industrial Development (CDTI) has been the main provider of raw data on the projects carried out and the companies participating in the *Innterconecta* programme. Finally, it was ARDÁN's<sup>1</sup> information that made it possible to construct the data for the indicators analyzed.

This section also describes the main data extracted from the projects carried out in the *Innterconecta* program in its calls for proposals in Andalusia. To this end, we will first synthesize the information on the projects financed, the samples of companies analyzed, and the technological areas involved.

Thanks to the projects financed by *Innterconecta*, around 2,000 companies have been able to carry out projects throughout Spain. Although the TF had mobilised more European resources in Andalusia, the slightly smaller size of the multiregional SGP projects has allowed a similar level of business participation to be maintained (Table 3). Based on previous data, the average number of participating companies per project was 4.17, also taking into account the participation of research organizations in the consortia.

The average amount of investment per company participating in the funded projects has been calculated as Total amount/Numb. of companies. The average budget of each of the 827 participating companies identified amounted to 639,679.85 €, while CDTI support covered almost half of this amount on average, with 302,406.91 €.

**Table 3.** Approved projects and participating companies in *Innterconecta*-Andalusia.

<b>CALL FOR PROPOSALS</b>	<b>Approved Projects (*)</b>	<b>Numb. Companies</b>	<b>Requested Projects (*)</b>	<b>Numb. Companies</b>
1st Reg. Call 2011	31	195	74	410
2nd Reg. Call 2013	41	211	59	255
3rd Call 2015*	131	511	269	946
4th Call 2016*	64	246	231	822
5th Call 2018*	67	229	N/A	N/A
<b>Total</b>	<b>334</b>	<b>1392</b>	<b>633</b>	<b>2433</b>

**Source:** Own elaboration based on data from CDTI and BOE. **Note:** \*Plurirregional

<sup>1</sup> The ARDAN database belongs to the Vigo Free Zone Consortium, and provides accounting information from companies' annual accounts.



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Of the more than eight hundred Andalusian companies identified as participants in the regional and multi-regional *Innterconecta* calls for proposals, data was available for a total of 337 companies that received grants between 2012-2020. In order to gain a deeper understanding of the impact of the *Innterconecta* programme on these companies, a comparison was made between the evolution of their indicators. On the other hand, the sample of companies of Andalusian origin participating in the programme analyzed has been compared to another general sample of 355 companies in the Autonomous Community that have not participated in the policy (represented as CS), and which has been extracted from ARDÁN. The control sample has been selected from a random sample of Andalusian companies in the Ardán database, but which have not participated in the policy analyzed. In addition, criteria such as the size of the companies, their status as previously innovative or not (in accounting terms) and the sectors of activity to which they belong have been taken into account.

With regard to the classification of the *Innterconecta* companies analyzed (337) and the control sample (355), the characteristics of both samples are quite similar (see Table 4).

Taking into account the description of the subsidized projects, we can see that they have been classified in technological areas. The technological areas to which the 337 companies participating in *Innterconecta* belong are mainly industrial manufacturing activities (34.12%) and professional, scientific and technical activities (27.60%), which often correspond to consultancy and specialised services. The rest of the *Innterconecta* resources went mainly to the following technological areas: information and communication technologies (9.20%), retail and wholesale trade (8.90%) and construction (8.31%).

Information about the registered offices of the companies participating in the policy analyzed is also provided below. These companies are concentrated primarily in Seville, Malaga and Cordoba, and to a lesser extent in Jaen. Other Andalusian territories have hardly any participation at all (Table 5). The map in Figure 1 also includes companies participating in the policy from other regions.

**Table 4.** Descriptive statistics of the projects analyzed at the beginning of the period.

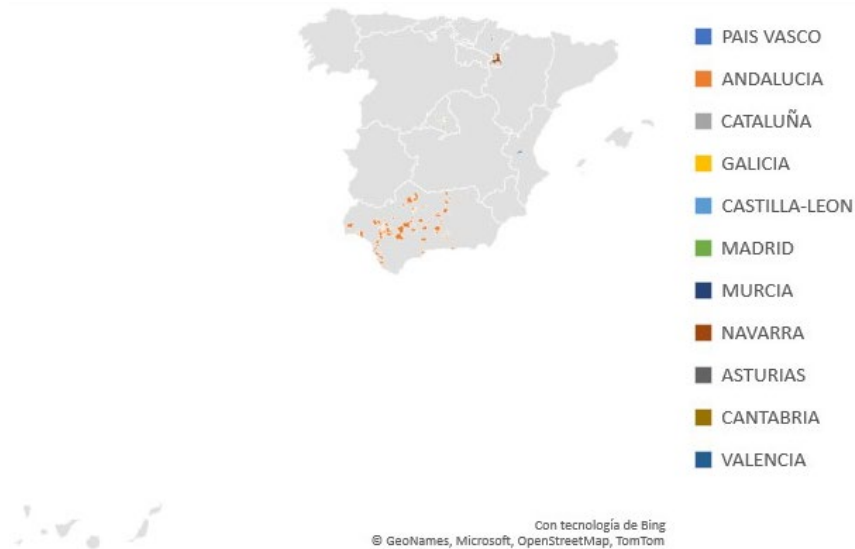
<b>Number of participating companies //</b>		337	355
<b>Control sample</b>	Small and Medium Enterprises	247 (73.29%)	345 (97.18%)
	Large Enterprises	90 (26.71%)	10 (2.82%)
<b>Number of companies per project</b>			4.17
<b>Role in the projects</b>	Leaders		63 (18.69%)
	Partners		274 (81.31%)
<b>Role in innovation of participants //</b>	Previously innovative (accountancy data)	10 (2.97%)	3 (0.85%)
<b>Control sample</b>	Non-innovative (accountancy data)	327 (93.03%)	352 (99.15%)

**Source:** Own elaboration based on ARDÁN and CDTI data

**Table 5.** Regions and Provinces to which the companies participating in the policy analyzed belong.

Region	Province	Numb. of firms	Total (%)	Region	Province	Numb. of firms	Total (%)	
Andalusia	Almería	28	8.31%	Galicia	A Coruña	3	0.89%	
	Cádiz	24	7.12%		Pontevedra	1	0.30%	
	Córdoba	26	7.72%	Basque Contry	Bizkaia	3	0.89%	
	Granada	19	5.64%		Guipúzcoa	1	0.30%	
	Huelva	7	2.08%		Ávala	1	0.30%	
	Castilla-León	Jaén	22	6.53%	Asturias	Oviedo	1	0.30%
		Málaga	32	9.50%	Cataluña	Barcelona	12	3.56%
	Sevilla	90	26.71%	Cantabria	Santander	1	0.30%	
Castilla-León	León	1	0.30%	Murcia	Murcia	1	0.30%	
Navarra	Pamplona	6	1.78%	Madrid	Madrid	57	16.91%	
Valencia	Valencia	1	0.30%					

**Source:** Own elaboration based on ARDÁN and CDTI data.



**Figure 1.** Spatial location of the companies participating in the Innterconecta programme in Andalusia, by registered office. Source: Own elaboration based on ARDÁN data (Sande, 2024)

#### 4. Data analysis

The first part of this section contains a comparative analysis of the evolution of the indicators analyzed. The second part analyses the data using the selected methodology.

#### 4.1. Comparative evolution of the indicators analyzed

The amount of resources allocated to the promotion of business innovation through the ERDF-*Innterconecta* programme has been significant for the Convergence regions, and especially in Andalusia. For this reason, the expected impact should be relevant (although it is true that part of the results can be assessed over a longer period of time). In order to characterise the impact of this programme in Andalusia, the behaviour of the main indicators of growth, results and innovation of the companies participating in this programme has been analyzed, without ignoring the fact that the evolution shown by these companies is also influenced by other factors of the socio-economic context, such as the systemic crisis suffered, legislative changes, the multiple corporate business management strategies, and others.

This paper deals with the evolution of the following three blocks of business indicators: the first group includes indicators related to business growth [revenue, gross value added (GVA) and employment], the second group includes indicators of business performance [profitability and result of the year], while the third group analyses the impact on innovation indicators [investment in research and development]. We take as a starting point the accounting information of the companies participating in *Innterconecta* obtained in raw form from the ARDÁN database.

The presentation of the information analyzed will make it possible to visualise the difference in the behaviour of the companies as a result of their participation in the *Innterconecta* programme.

When analyzing the aggregate change of the indicators, the Andalusian companies participating in the *Innterconecta* programme generally show positive results in all the previously selected indicators: revenue, GVA, employment, economic profitability, result for the year and investment in development, with the exception of research investment. Table 6 summarizes the information on the relative impact for each sample.

Utilizing outcome indicators for the Difference-in-Differences (DiD) analysis allows assessing the impact of funding on the specific outcomes of interest. This combined approach can help address potential selection bias, control for confounders, and provide a robust estimation of the treatment effect. We estimate the causal effect of funding on these outcomes. DiD Effect has been calculated as follows = (Outcome in Treatment Group, Post-Intervention - Outcome in Treatment Group, Pre-Intervention) - (Outcome in Control Group, Post-Intervention - Outcome in Control Group, Pre-Intervention). A statistically significant and positive DiD effect would imply that the intervention (innovation funding) had a positive impact on the outcomes of interest. The results show that, in general, the outcomes for the treatment group (INT) did not improved more than those for the control sample (CS) after the intervention (Table 7).

**Table 6.** Aggregate change and relative impact after business participation in *Innterconecta* by indicators

Sample	Income (€)	GVA (€)	Employment (n° jobs)	Profitability (%)	Result for the year (€)	Research Invest. (€)	Development Invest (€)
Innterconecta Companies	4,843,392,963 (+)	5,617,463,938 (+)	48,494 (+)	0.01 (-)	-1,103,529,238 (+)	10,320,772.88 (+)	112,441,237.3 (+)
Control Sample	8,722,662,171 (+)	1,879,833,987 (+)	36,414 (+)	0.04 (+)	301,259,773 (+)	11,858,106.54 (+)	75,893,895.83 (+)

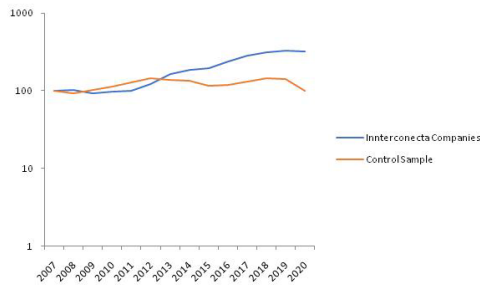
**Source:** Own elaboration from ARDÁN and CDTI data.

**Table 7.** Outcome Indicators for DiD of the groups studied (€,%)

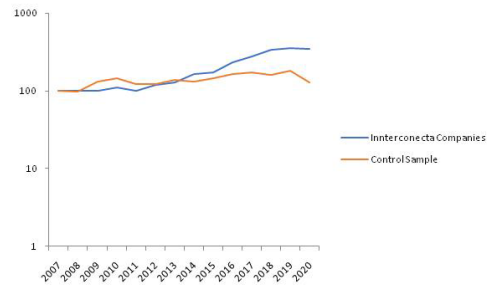
Sample	Revenue	GVA	Employees	Profitability*	Result of the Year	Research Invest.	Development Invest.
Int-CS	-3,879,269,208	3,737,629,951	12,080	-0.053	-1,404,789,011	-1,537,333.66	36,547,341.43
Int-CS (%)	-218.17	-216.08	-280.67	-172.60	-347.07	320,981.89	-4,597,553.88

Source: Own elaboration based on Ardán and CDTI data. Note: \*%

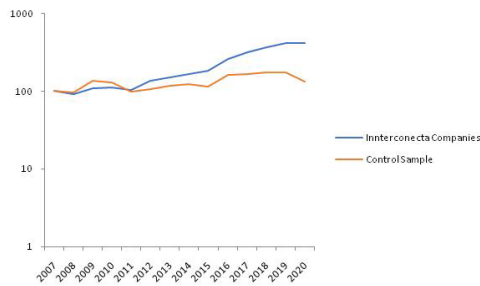
The graphical analysis shows a positive evolution for the values of all the indicators analyzed, with the sole exception of investment in research. Precisely when it comes to a policy aimed at promoting business innovation (see Figures 2 to 9).



**Figure 2.** Comparative evolution of revenue, Interconecta-Andalusia companies 2007-2020, (index 2007=100, log10(x))



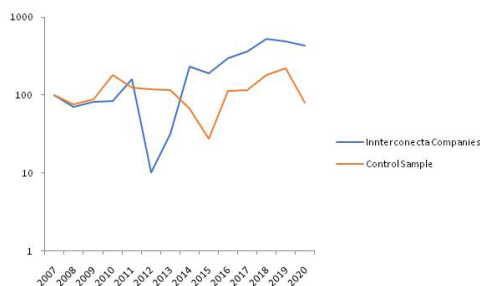
**Figure 3.** Comparative evolution of GVA, Interconecta-Andalucía companies 2007-2020, (index 2007=100, log10(x))



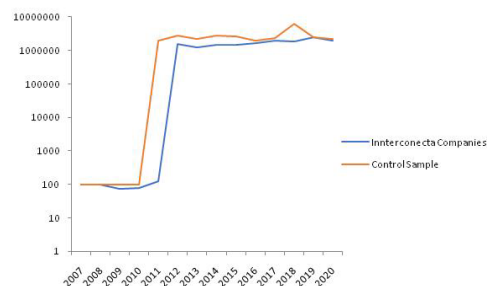
**Figure 4.** Comparative evolution of employment, Interconecta-Andalucía companies 2007-2020, (index 2007=100, log10(x))



**Figure 5.** Comparative evolution of profitability, Interconecta-Andalucía companies 2007-2020, (index 2007=100, log10(x))

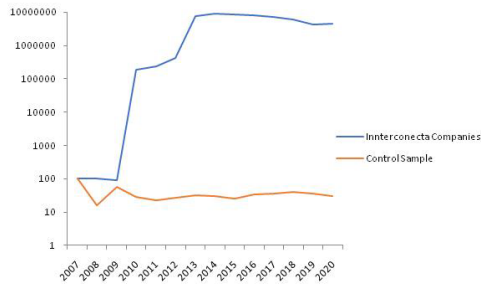


**Figure 6.** Comparative evolution of result of the year, Interconecta-Andalucía companies 2007-2020 (index 2007=100, log10(x))



**Figure 8.** Comparative evolution of research investment, Interconecta-Andalucía companies 2007-2020, (index 2007=100, log10(x))

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**Figure 9.** Comparative evolution of development investment, Innterconecta-Andalucía companies 2007-2020, CNAE C, F, G, J, M (index 2007=100)

### 4.2 Statistical analysis

As it was explained in the methodology section, we used the Propensity Score Matching (PSM) methodology for the statistical analysis, which analyses the covariances between two groups of values: on the one hand, the companies not participating in the policy and, on the other, the participating companies. The results of the statistical analysis would indicate that there is a significant difference for both groups. The participation of innovative companies in the *Innterconecta* programme would have a significant impact on four of the indicators analyzed: revenue, GVA, employment and investment in development (Table 8).

**Table 8.** Results of the statistical analysis of business indicators using PSM.

	Revenue	GVA	Employment	Profitability	Result of the year	Research investment	Development investment
<i>Companies control sample (MC)</i>	338	334	338	337	336	17	41
<i>Companies Innterconecta</i>	232	232	231	232	232	16	60
$\bar{x}$ control sample	37,594,951.57	7,748,712.04	145.87	0.07	1,170,650.66	697,571.59	1,851,110.89
$\bar{x}$ Innterconecta	240,967,630.71	58,883,060.40	624.60	0.04	14,388,704.16	621,703.48	5,678,831.06
$\sigma$ control sample	94,740,323.08	15,045,398.71	305.85	0.13	8,052,397.65	1,859,626.66	6,711,620.05
$\sigma$ Innterconecta	1,069,090,259.76	251,410,141.20	1,760.90	0.13	185,986,867.98	1,939,440.07	15,409,012.33
<i>d-index (DME)</i>	0.268	0.287	0.379	0.232	0.100	0.040	0.322
<i>p-value</i>	0.007431	0.003692	0.0003532	0.703	0.292	0.7966	0.045

Table 9 lists the results observed for each of the main business indicators analyzed.

**Table 9.** Summary of the results of positive impact (+), or not demonstrated (=) of the analyzed policy, by indicator

	Revenue	GVA	Employment	Profitability	Result of the year	Research Investment	Development Investment
<b>Innterconecta Companies</b>	+	+	+	=	=	=	+

## **5. Conclusions**

The conclusions of this paper can be divided into two sub-sections. The first relates to policy implications, while the second draws the main recommendations derived from the results of this research.

### **5.1. Implications**

The TF and SGP, endowed with significant amounts to promote technological development in Andalusia in the 2007-2013 and 2014-2020 programming periods, raised expectations for the development of business innovation within the Andalusian Innovation System. However, the positive results observed for several of the indicators (revenue, GVA, employment and investment in development) should not distract us from the lack of impact on others (results of the exercise, profitability and research investment), making the achievements more moderate than apparently expected. Thus, while previous studies for other Autonomous Regions showed a positive, albeit moderate, impact of the ESIF for innovation on the main innovation indicators of firms (Sande & Vence, 2021), the present study partially confirms this general result (innovation research is an exception). Regarding growth and performance indicators, this study confirms the results of previous research in other regions (Sande, 2022a; Sande, 2024).

### **5.2. Recommendations**

As a consequence of the above results on the impact of the policy on business innovation in Andalusia, and with a view to achieving greater efficiency in the results of R&D&I policies (particularly for investment in research), smaller projects could have been set up, which would have made it possible to finance initiatives that responded to a greater extent to the possible investment needs of the smaller business fabric, particularly SMEs, which constituted a specific objective of the programme. Similarly, more specific objectives could have been included in these innovation programmes, which would facilitate the evaluation of funding for the innovation ecosystem (e.g. indicating expected sectoral impacts in terms of employment, expected benefits, patents, etc.). Similarly, it would be worth considering whether these types of programmes aimed at reducing the innovation gap in the peripheral territories should have incorporated measures that would make it possible to more clearly promote the priority thematic areas defined in the regional Smart Specialisation Strategy, which would facilitate greater alignment between policies and strategies while promoting those areas with the greatest technological projection.

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