INVESTMENT AND PRODUCTIVITY IN THE AGRO-INDUSTRIAL SECTOR: A CASE STUDY

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Abstract

The productivity of a sector, an important determinant of competitiveness, depends, among other factors, on the investment made. In this context, the main aim of this work is to explore the relation between investment and productivity trends, based on the amounts of investment made in the agri-food industry in Northern Portugal (NUT II), as well as the asymmetries at sub-regional level, during the last two EU support frameworks, namely QREN (2007-13) and Portugal 2020 (2014-2020). This study will start by gathering information from organizations that manage EU funds related to the beverage and food industries. This data will be categorized by subsectors and regions to estimate access. The research will then analyse productivity trends in these sectors and the impact of investment on productivity using statistical analysis techniques. The results show that there is a positive and significant relation between gross fixed capital formation and the productivity of both industries: food and beverage. In what refers, specifically to the beverage industry, we obtain significant results in the elasticity model. The findings show that it possible to gauge the effectiveness of policies to support investment, namely by identifying the most dynamic sectors in terms of attracting funds and with the greatest impact in terms of productivity, i.e. assessing the return on investment that is essentially private and supported with public funds, as well as identifying strategic sectors and promoting transparency and accountability in the management of public resources.

Keywords: productive specialization, clusters, regional development

JEL classification: R12, R58

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Introduction

Investment is a variable that has long gained particular prominence in economic and social analyses, especially since the concepts of GDP multiplier and accelerator were developed. Likewise, its particularly virtuous nature as an engine of growth has been demonstrated, as opposed to other possibly less sustainable engines, such as private or public consumption. In addition, the so-called externalities (or spillover effects) of investment have been recognised as very beneficial for economic growth and development, facts that, taken together, make investment a variable that analysts are particularly attentive to and which justify investment decisions being supported and often, especially in the case of foreign direct investment, witnessing real disputes between local agents in order to attract investment to their territories (Ramos, 2006).

Since Portugal joined the European Union (EU) in 1986, it has received a significant amount of support for investment in various areas, under various funding agreements, which reflect the economic, social and territorial development policy defined to promote the country, taking into account the established State Budgets.

This financial support comes from the five European Structural and Investment Funds, namely the European Regional Development Fund (ERDF) and the European Social Fund (ESF), the European Agricultural Fund for Rural Development (EAFRD), as well as the current European Maritime, Fisheries and Aquaculture Fund (EMFAF) and the Cohesion Fund.

In this study, we will analyse the investment made in the agri-food industrial sector in the north of Portugal from 2007, when the "Quadro de Referência Estratégico Nacional (QREN)"/ National Strategic Reference Framework began to be implemented, until 2020, the final year of the most recently implemented framework, Portugal 2020 (PT2020).

Subsequently, the relationship between realised investment and productivity trends in the two sub-sectors of the agri-food industry will be studied, specifically the food industry and the beverage industry. After discussing the results, the main conclusions to be drawn will be presented, as well as pointing out the limitations encountered and avenues for future research.

1. Context

1.1. Conceptual framework

Economic theory has always identified investment as one of the determining factors of economic growth. This relationship, although it takes different forms, can be seen in the approaches associated with both the classical and neoclassical currents of economic thought, as well as the Keynesian and neo-Keynesian perspectives (Silva and Sequeira, 2011). Investment, whether it is made to increase the capital intensity of the production process, focusing on technological progress, research and development or improving human capital, always aims to improve the conditions and characteristics of production, making productive activities more profitable and competitive. Recently, studies that consider the territorial dimension of competitiveness, and the rationale based on regional innovation systems, suggest that the effects of investment are reflected in improved collective business efficiency once business clusters benefit from positive externalities arising from specialisation, reduced transaction costs, reduced uncertainty and the diffusion of innovative practices (Silva and Sequeira, 2011).

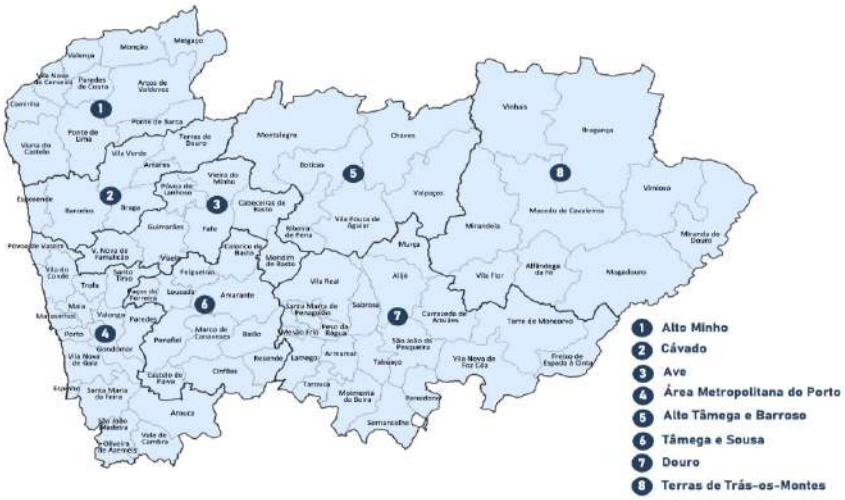
In Portugal, following integration into the European Union, most investment processes, whether private (entrepreneurial) or public, have benefited from the support of EU funds, many of which are structural. This funding has always been aimed at reducing development asymmetries from two perspectives: on the one hand, for the country in relation to the rest of the more developed member states and, on the other hand, internally, for the less developed regions in comparison to those with greater economic dynamism. Investments in environmental, social, cultural, productive, commercial and transport infrastructure, with the support of the structural funds, have profoundly transformed the country's territorial configuration, making it much less unequal basic conditions of access to quality of life (Mateus, 2013). Investment supported by European funding has made it possible to bring Portuguese regions closer together in terms of the living conditions offered to their populations, in areas such as housing, access to energy and sanitation, health, education or the 'road' distances between the country's main urban centres. Mateus (2013) consider that cohesion investments were prioritised over competitiveness and investments in potential conditions over the effective results of economic and social

development. According to the author, this choice has not made it possible to build regional dynamics of cumulative convergence of equal opportunities for both people and companies, whether in access to the most advanced factors of value creation (knowledge, culture, creativity) or in access to income generated outside the context of public policy action (Mateus, 2013). In this respect, Costa (2019) considers that, as a result of the regional policy pursued, there have been good results from the point of view of promoting territorial equity (access of citizens living in different territories to public goods and services and merit goods) but from the point of view of territorial competitiveness (the ability of territories to generate employment and income for their residents) the results have been insufficient.
In this context, analysing the contribution of investment to productivity is fundamental. Productivity is nothing more than a measure of economic efficiency that calculates the relationship between the resources used in the production (inputs) and the final product (outputs). But it is based on the measure and value of productivity in the productive sectors that countries and regions identify their wealth creation and competitive capacity. Studies carried out to assess the impact of European funding on Portuguese companies show that companies with approved projects have higher levels of employment, turnover, gross value added, productivity, capital and exports compared to those that have not received support, and these differences prevail over time (Cabral and Campos, 2023).
The effects of investment in the productivity of food and beverage sector in northern Portugal are analysed below. Even though manufacturing industry is losing weight in wealth creation in Portugal, this activity sector is among the largest contributors to industrial production.

1.2. A brief characterisation of the northern region and its agri-food industry sector

The region under study, the North of Portugal, is a level II region under the terms of the Nomenclature of Territorial Units for Statistics (NUTS) approved by the European Commission. The Norte region includes 86 municipalities, organised into eight Intermunicipal Communities (CIM), which make up eight level III regions (NUT III), as can be seen in figure 1.

Figure 1. The territorial distribution of the northern region of Portugal, by NUT III and municipality, 2024



Source: CCDR-N (2024)

With a population of around 3.6 million, the Northern Region is home to almost 35 per cent of Portugal's resident population, accounts for almost 35 per cent of national exports and represents around 30 per cent of the national economy's GDP (CCDR-N, 2024).
However, it is a region with deep asymmetries between the inland territories, with large areas considered to be low density and serious problems of economic and social cohesion, and the coastal area, which is richer and more populated.

Specifically, according to the information in Table 1.A in the appendix, with data for the year 2021, we can verify that although the north has a higher population density (169.4 inhabitants per square kilometre) than the average for Portugal, the inland regions, such as Terras de Trás-os-Montes (19.4), Douro (45.7) and Alto Tâmega (28.8) have very low densities. The level of education, shown in the table by the percentage of the population with a level of schooling upper than secondary, also indicates that the population of these NUT IIIs is less qualified and much older, a situation visible through the ageing index. The purchasing power and development index indicators, which are also present in the table, are index numbers that have a value of 100 for the country, and it can be seen that all regions, with the exception of the Oporto metropolitan area, have lower values, thus proving the situation of relative poverty and development lags.

As for the data on companies, we would emphasise the weight of the primary sector in regions such as Terras de Trás-os-Montes and the Douro, the latter being a deeply wine-growing region that includes the Alto Douro Vinhateiro, considered a World Heritage Site by Unesco in 2001.

As for the agri-food industry sector, which includes the food industry itself and the beverages industry, the North represents around 32 per cent of the number of companies in the country and, in 2021, (Table 2.A in the appendix) the gross added value (GVA) of the agri-food industry sector in the region totalled 989 M€, distributed 56 per cent by the food industry and 44 per cent by the beverages industry. This amount corresponds to 29% of the sector's gross value added at national level, as well as the same percentage in relation to the volume of employment. In terms of Gross Fixed Capital Formation (FBCF), the north has a relatively lower share, around 26 per cent.

However, investment is a broader concept than gross fixed capital formation, including other types of investment of an intangible nature, from investment in innovation and development, to strengthening labour capacities through human capital formation, and other activities that are fundamental to competitiveness. Thus, we are proceeding to analyse the investment made in the region during the most recent EU financial support frameworks.

2. Objectives and methodology

The first objective of this work is to assess the amounts of investment made in the agri-food industry in the north of Portugal (NUT II region) during the last two EU support frameworks, namely QREN (2007-13) and Portugal 2020 (2014-2020). This access to the region will be analysed both in absolute terms, by amount of investment and type of agri-food industry, and in relative terms, by comparison with the country as a whole. We will also try to ascertain possible asymmetries at sub-regional or NUT III level.

The second objective is to analyse the relationship between the investment realised and the evolution of the sector's productivity.

In methodological terms, and after a theoretical review, the empirical work began by reconstituting or identifying the various programmes that supported the sector and the corresponding management entities of these Community programmes (QREN,2023; PT20220, 2023).

Subsequently, data on projects carried out in the Northern region and funded under the QREN and PT2020 was requested from the "Agência para o Desenvolvimento e Coesão, I.P" (AD&C, 2023a and 2023b). We also analysed data from the specific agricultural support programmes, namely the "Programa de Desenvolvimento Rural" (PRODER) during the period corresponding to the operation of the QREN (2007-2013) and the "Programa de Desenvolvimento Rural de Portugal" (PDR 2020) during the PT2020 period (2014-2020), information provided by the "Instituto de Financiamento da Agricultura e Pescas, I.P". (IFAP, 2023).

After receiving lists of around 1,800 projects, they were analysed and classified based on various grouping criteria, namely by territorial unit and by sector. From these analysed lists, tables were drawn up to allow a comparative analysis of the relative dynamism of the various industries in the agri-food sector and the regions.

As regards the relationship between these investments and the evolution of productivity, the fact that the project lists in most cases did not indicate the municipality compromised the size of the sample for statistical purposes, so it was necessary to use another set of variables.

For this purpose, information on the FBCF of companies in the sector at municipal level was requested from INE-Statistics Portugal (INE, 2024g). As for productivity, the concept of labour productivity was

used, i.e. it was calculated using the ratio between Turnover/Number of Workers and thus the variation in productivity between the initial and final year under analysis was estimated.
The impacts of investment (FBCF) on the productivity of food and beverage industries was estimated using two simple regression models:

$$Ln(Prod)_i = \beta_0 + \beta_1 Ln(FBCF)_i + \varepsilon_i Ln(Prod)_i = \beta_0 + \beta_1 Ln(FBCF)_i + \varepsilon_i \quad (1)$$

Where Prod refers to the productivity level of each industry and FBCF the level of respective investment.
In order to assess the validity and consistency of the estimated models, the Reset test for model specification was applied, such as Jarque-Bera test for normality of errors and Breush-Pagan to teste the presence of homoskedasticity.
We also estimated the impact of investment in the annual variation of productivity. The equation in the base for this model was the following:

$$Var\_Prod_i = \beta_0 + \beta_1 Ln(FBCF)_i + \varepsilon_i Var\_Prod_i = \beta_0 + \beta_1 Ln(FBCF)_i + \varepsilon_i \quad (2)$$

The main goal is to assess the impact of investment (in percentual terms) on the possible increase in productivity between investment programmes.

3. Results

3.1. Access to EU funds for the agri-food industrial sector in the northern region

As mentioned above, Portugal has been receiving investment support since it joined the European Union. Focusing the analysis on the 2007-2020 period, it can be seen that this investment support fell under two support agreements, and it is estimated that Portugal received 21.5 billion euros (M€) of support under QREN, which, added to the estimated 25 billion euros under PT2020, totals more than 46 billion euros (AD&C, 2023b), i.e. an average of more than 2% of annual GDP (Pordata, 2023).
With regard to access to the agro-industrial sector, and according to the methodology indicated, after identifying the programmes that supported this sector, we obtained the project lists, which allowed us to construct table 1, with an overview of the situation.
During this period from 2007 to 2020, the agri-food industry in the North (NUT II) presented projects corresponding to an investment of 1,214.93 M€ and representing around 32.1% of the total value for Portugal, as shown in Table 1, built with the values available at the time. This investment was supported by public spending, corresponding to EU funds and the respective national contribution, totalling 453.83 M€, thus absorbing 34.5% of the public spending approved in this regard for the country as a total.
Continuing the analysis of Table 1, we observe that within the support for the agri-food industry in the north, the support received through the "Programa Operacional Fatores de Competitividade" (16.8% of the total support for the 2007-20 period) was particularly noteworthy during the QREN period; In the PT2020 period, the "Programa Operacional de Competitividade e Internacionalização" (34.9%) stands out, as does the "medida relativa ao apoio ao Investimento na Transformação e Comercialização de Produtos Agrícolas" under the PDR (11.4%). In total, these 4 instruments accounted for more than 80 per cent of the total public spending on support for the agri-food industry in the North.
Also, with regard to the distribution of investment and support by programme, in general there was a similar distribution between the North and Portugal, with the exception of QREN, which had a greater relative importance in supporting the North (21% of total support, compared to 14.6% for Portugal), while the situation was reversed under PRODER (29.6% for Portugal and 18.4% for the North, in terms of relative distribution).

Table 1. Investment in the agri-food industry in NUT II Norte, by programme (2007-2020)

Agri-food industry projects (CAE 10+11)							
Period	Programme	Projects		Investment		Public expenditure	
		Nº	% Total	Value (10^3 €)	% no Total	Value (10^3 €)	% Total
2007-2013	**QREN:**						
	Fatores de Competitividade	108	5.9%	143 286	11.8%	76 467	16.8%
	Regional Centro	1	0.1%	462	0.0%	230	0.1%
	Regional Norte	130	7.1%	30 639	2.5%	18 607	4.1%
	Total QREN Norte (CAE 10+11)	239	13.1%	174 387	14.4%	95 304	21.0%
	Total QREN Portugal (CAE 10+11)	685	12.2%	376 858	10.0%	191 586	14.6%
	PRODER:						
	Modernização e capacitação empresas	260	14.2%	302 426	24.9%	81 762	18.0%
	Criação e desenvolv. microempresas	55	3.0%	3 921	0.3%	1 710	0.4%
	Total PRODER Norte (CAE 10+11)	315	17.3%	306 347	25.2%	83 472	18.4%
	Total PRODER Portugal (CAE 10+11)	1 023	18.2%	1 296 635	34.3%	389 620	29.6%
Total Norte CAE10+11 (2007-2013)		**554**	**30.4%**	**480 733**	**39.6%**	**178 776**	**39.4%**
Total Portugal CAE 10+11 (2007-2013)		**1 708**	**30.4%**	**1 673 493**	**44.2%**	**581 206**	**44.2%**
2014-2020	**PT2020:**						
	Programa Op. Comp. e Internacionalização	403	22.1%	341 676	28.1%	158 225	34.9%
	Programa Op. Inclusão Social e Emprego	3	0.2%	86	0.0%	86	0.0%
	Programa Op. Regional Norte	308	16.9%	113 846	9.4%	46 041	10.1%
	Total PT2020 Norte (CAE10+11)	714	39.1%	455 609	37.5%	204 352	45.0%
	Total PT2020 Portugal (CAE10+11)	2 225	39.6%	1 256 897	33.2%	505 851	38.5%
	PDR:						
	Invest. Transf. e Comerc. Prod. Agrícolas	219	12.0%	226 748	18.7%	51 727	11.4%
	Pequenos Investimentos	206	11.3%	38 227	3.1%	11 977	2.6%
	Pequenos Inv. Transf. C. Prod. Agrícolas	132	7.2%	13 618	1.1%	7 002	1.5%
	Total PDR Norte (CAE10+11)	557	30.5%	278 594	22.9%	70 706	15.6%
	Total PDR Portugal (CAE10+11)	1 688	30.0%	854 470	22.6%	228 017	17.3%
Total Norte CAE10+11 (2014-2020)		**1 271**	**69.6%**	**734 202**	**60.4%**	**275 058**	**60.6%**
Total Portugal CAE 10+11 (2014-2020)		**3 913**	**69.6%**	**2 111 367**	**55.8%**	**733 867**	**55.8%**
Total Norte CAE 10+11 (2007-2020)		**1 825**	**100%**	**1 214 936**	**100%**	**453 833**	**100%**
Total Portugal CAE 10+11 (2007-2020)		**5 621**	**100%**	**3 784 859**	**100%**	**1 315 074**	**100%**
Norte/Portugal (2007-2020)		**32,5%**		**32.1%**		**34.5%**	

Source: Own elaboration through AD&C(2023a), and IFAP (2023)

Note: it was decided to keep the name in the original language of each programme, as they are mostly programmes for Portugal.

As for the total of 1,825 projects submitted to date, there was a significant 130% increase in the number of projects between the two programming periods (554 projects in the QREN period and 1,271 in the PT2020 period). Although this was not proportionally reflected in terms of the amount of investment and support received (480.73 M€ and 734.2 M€ respectively of investment in each period, and corresponding to actual public expenditure of 178.77 M€ and 275.05 M€), which translates into a significant decrease in the average size of projects during the periods under study.

According to the Portuguese Classification of Economic Activities (CAE) in its current version CAE-rev.3 (INE, 2007), since the agri-food industry is made up of the food industry (CAE 10) and the beverage industry (CAE 11), table 2 shows the breakdown of this investment and support between the two CAEs.

Table 2. Projects executed in the North by CAE (2007-2020)

Period	Programme	CAE											
		CAE 10 - Food industries						CAE 11 - Beverage Industries					
		Projects		Investment		Public expenditure		Projects		Investment		Public expenditure	
		Nº	%	10^3€	%	10^3€	%	Nº	%	10^3€	%	10^3€	%
2007-2013	QREN	137	13%	87 856	13%	54 199	19%	102	13%	86 531	16%	41 105	25%
	PRODER	135	13%	123 188	18%	37 376	13%	180	23%	183 159	35%	46 096	28%
	2007-13	**272**	**26%**	**211 044**	**31%**	**91 575**	**32%**	**282**	**35%**	**269 689**	**51%**	**87 201**	**52%**
2014-2020	PT2020	524	51%	352 622	51%	160 939	56%	190	24%	102 986	20%	43 413	26%
	PDR	231	22%	125 700	18%	34 254	12%	326	41%	152 894	29%	36 452	22%
	2014-20	**755**	**74%**	**478 323**	**69%**	**195 193**	**68%**	**516**	**65%**	**255 880**	**49%**	**79 865**	**48%**
Norte 2007-20		**1027**	**100%**	**689 366**	**100%**	**286 768**	**100%**	**798**	**100%**	**525 569**	**100%**	**167 066**	**100%**

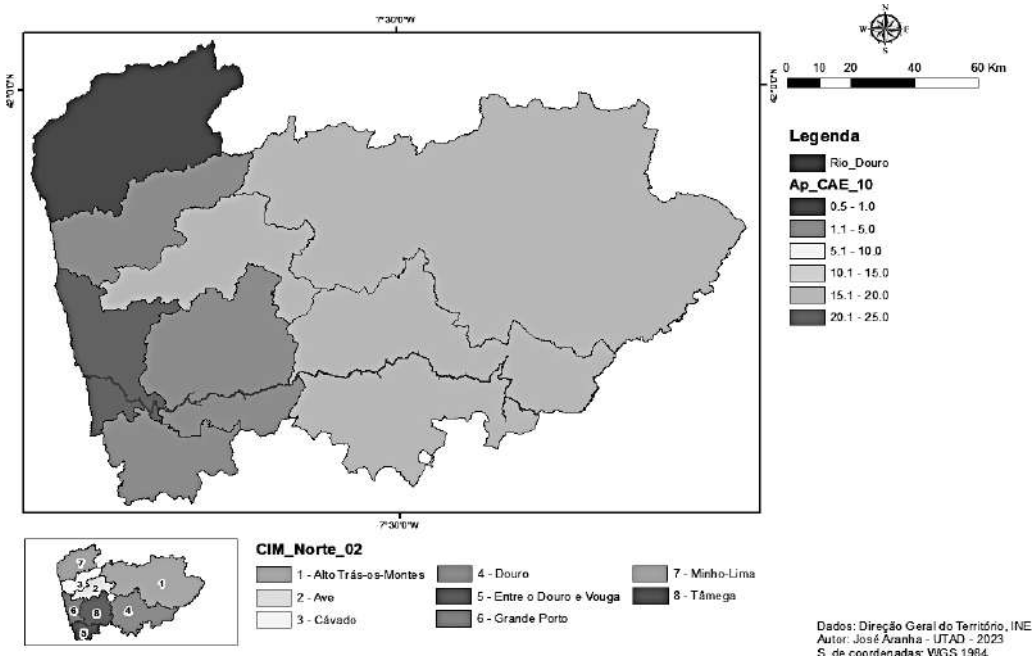
Source: Own elaboration through AD&C (2023a), and IFAP (2023)

It can thus be concluded that in the agri-food industry sector and over the total period 2007-2020, investment and public spending by the food industries (CAE 10) were higher than those by the beverage industry (CAE 11): 689.3 M€ of investment and 286.7 M€ of support received by the CAE 10 industries, compared to 525.5 M€ and 167 M€, respectively, by the CAE 11 industries.

Furthermore, while the overall performance of the food industries was better than that of the beverage industries (around 72% of the support received), there is a difference in behaviour between the two EU support frameworks: in fact, during the QREN and PRODER (2007-13) the values were more similar (211 M€ of investment and 91.5 M€ of support for CAE 10; and respectively 269.6 M€ and 87.2 M€ for CAE 11); in the second framework, the 2014-20 PT2020, the food industries invested and received much more (478.3 M€ of investment and 195.1 M€ of support for CAE 10, against 255.8 M€ and 79.8 M€, respectively, for CAE 11).

The following figures show the investment and public spending figures for the two CAEs, broken down geographically by NUT III. It should be noted that the change in the territorial composition of the NUT III during the period under analysis - namely the change from the 2002 to the 2013 version of the NUT III - meant that the data could not be presented together, making it necessary to analyse each sub-period separately. As a result, in the period 2007-2013, and based on the NUTS III (2002 version), the distribution of support for the food and drink industries was as shown in Figures 2 and 3.

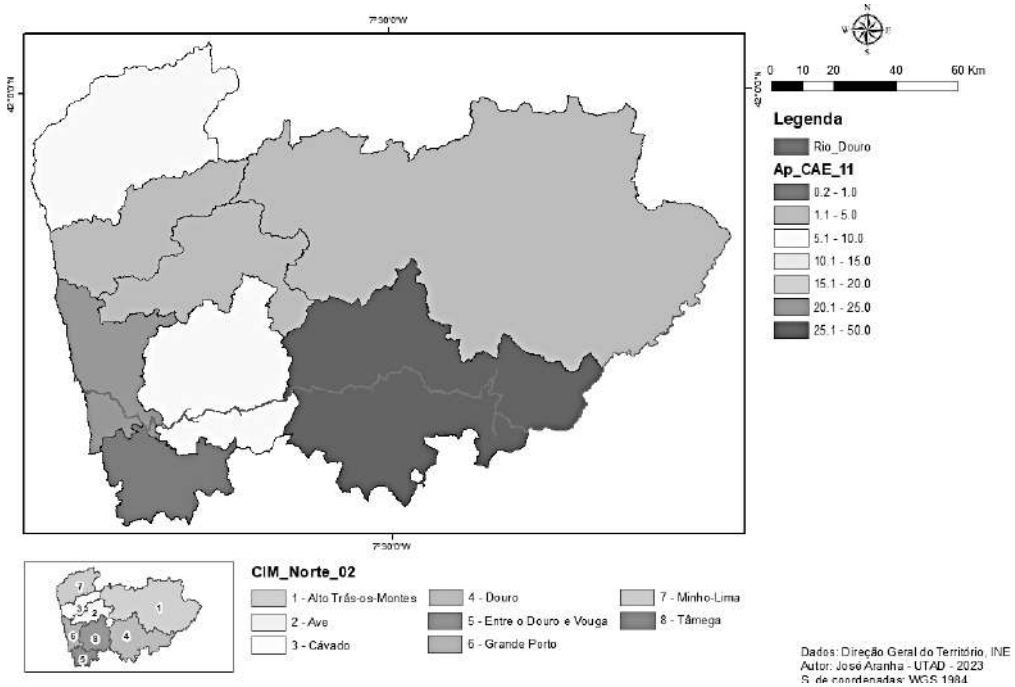
Figure 2. Distribution of support for food industry projects (CAE10), 2007-13, NUT III (2002)



Source: Own elaboration through AD&C (2023a), and IFAP (2023)

Analysing Figure 2, it can be observed that in the 2007-2013 period, in terms of the food industry, Greater Porto (absorbing 20.8% of the support received by the agri-food industry in the North), and Ave (19.8%), Alto Trás-os-Montes (16.3%) and Douro (16.1%), lead the way in attracting funds. For the same period, in terms of the drinks industry, the Douro stands out (44.5 per cent of support), followed by Greater Porto, with 24.7 per cent of approved public spending (Figure 3).

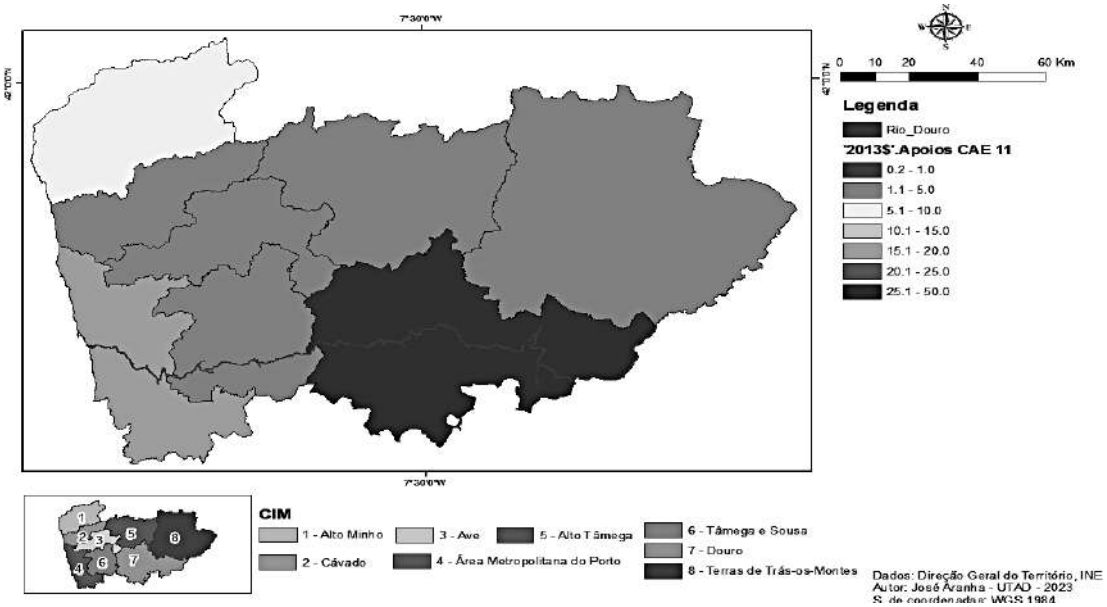
Figure 3. Distribution of support for beverage ind. projects (CAE11), 2007-13, NUTIII (2002)



Source: Own elaboration through AD&C (2023a), and IFAP (2023)

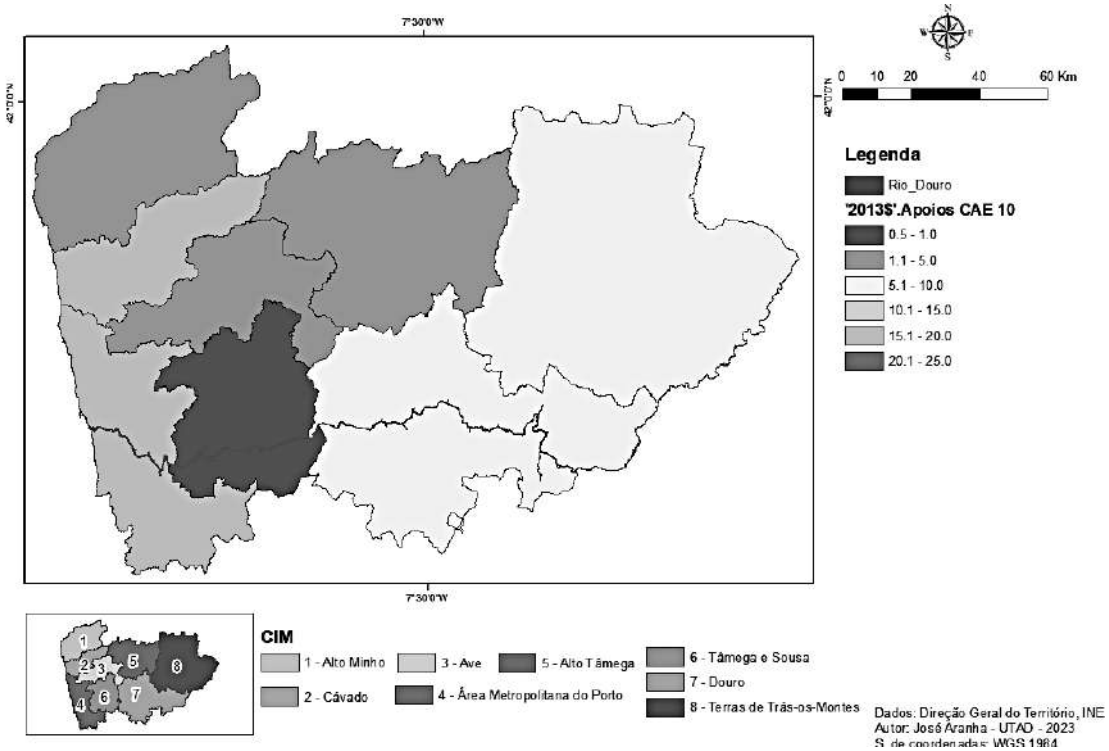
In the subsequent period, 2014-20, based on the current NUT III (2013) and as shown in Figure 4, the importance of the drinks industry, the Douro (with 26.6 per cent of support, although with a relative decrease compared to the previous table) and the so-called Area Metropolitana do Porto (AMP), with 16.7 per cent of public spending or support, also decreasing compared to the previous table, is maintained. It should be noted, however, that the geographical composition of NUT III has changed.

Figure 4. Distribution of support for beverage ind. projects (CAE11), 2014-20 NUT III (2013)



Source: Own elaboration through AD&C (2023a), and IFAP (2023)

Figure 5. Distribution of support for food industry projects (CAE10), 2014-20 NUT III (2013)



Source: Own elaboration through AD&C (2023a), and IFAP (2023)

In the food industries (Figure 5), the relative importance of AMP is also preserved, although less than in the previous period (15.7 per cent of support) and the importance of Cávado (which went from 4 per cent in the previous period to 17.7 per cent in this period). On the other hand, the Douro and Terras de Trás-os-Montes fell significantly compared to the previous period (the Douro fell to 5.9 per cent, while Terras de Trás-os-Montes fell to 6.6 per cent), but this may have been due, as already mentioned, to the change in the composition of the NUT III in terms of municipalities.
By analysing the subclasses of activity in these industries, table 3 provides more detailed information.

Table 3. Investment and public spending by specific CAE, 2007-2020

CAE	Denomination	Investiment		Public expenditure	
		10^3€	%	10^3€	%
10	**Food industries**:				
101	Slaughtering animals, preparing and preserving meat and meat products	182 163	15,0%	72 219	15,9%
102	Preparation and conservation of fish, crustaceans and molluscs	4 394	0,4%	3 478	0,8%
103	Preparation and preservation of fruit and vegetables	139 252	11,5%	52 396	11,5%
104	Production of animal and vegetable oils and fats	32 162	2,6%	11 713	2,6%
105	Dairy industry	91 372	7,5%	26 994	5,9%
106	Processing of cereals and leguminous plants; manufacture of starches and related products	20 034	1,6%	8 220	1,8%
107	Manufacture of bakery products and other flour-based products	82 668	6,8%	42 597	9,4%
108	Manufacture of other food products	112 851	9,3%	56 599	12,5%
109	Manufacture of animal feed	9 840	0,8%	7 757	1,7%
10	Other not specified	14 632	1,2%	4 793	1,1%
	TOTAL CAE 10 - Food industries	**689 366**	**56,7%**	**286 768**	**63,2%**
11	**Beverage industry:**				
1101	Manufacture of distilled alcoholic beverages	2 935	0,2%	1 559	0,3%
1102	Wine industry	438 144	36,1%	130 429	28,7%
1103	Manufacture of cider and other fermented fruit beverages	721	0,1%	333	0,1%
1104	Manufacture of vermouths and other fermented beverages	1 669	0,1%	401	0,1%
1105	Brewing beer	59 153	4,9%	26 236	5,8%
1107	Soft drink manufacturing; production of natural mineral waters and other	10 253	0,8%	4 130	0,9%
11	Other not specified	12 695	1,0%	3 978	0,9%
	TOTAL CAE 11 - Beverage industry	**525 569**	**43,3%**	**167 066**	**36,8%**
	Total North - Agri-food industries	**1 214 936**	**100,0%**	**453 833**	**100,0%**

Source: Own elaboration through AD&C (2023a), and IFAP (2023).

Thus, within the food industry and according to table 3, the following industries stand out: 101 - Slaughtering animals, preparing and preserving meat and meat products (with 15.9 per cent of the total support received by the agri-food industry in the 2007-2020 period); 108 - Manufacture of other food products (12.5 per cent); 103 - Preparation and preservation of fruit and vegetables (12.5 per cent); 103 - Preparation and preservation of fruit and vegetables (11.5%) and 107 - Manufacture of bakery and other flour products (9.4%) and, further away, 105 - Dairy industry (5.9%).
In terms of the drinks industry, it is practically concentrated in CAE 1102 - Wine industry (28.7 per cent of support from the agri-food industrial sector) and CAE 1105 - Brewing beer (5.8 per cent of total support). After analysing the agri-food industry's investment projects, in the next section we will try to establish a relationship between the investment made in this period and the sector's productivity evolution.

3.2. **Impact of investment on the sector's productivity**

As mentioned in the section on methodology, the first intention was to relate the investment supported by EU funds analysed in the previous section to the evolution of productivity. However, the lack of complete information at territorial level in the lists of projects received, namely the absence of information on the municipality where the investment took place for a large number of projects, impeded the use of this variable. The alternative found was to use the variable Gross Fixed Capital Formation (FBCF) for companies in the sector, at county level. The data on this variable is statistical information that is not available on the portal and can only be provided on request, which happened to be the case.
Therefore, the following work is based on the FBCF variable - data available for the years and for the companies in the sector under study (agri-food industry and the corresponding subdivision between food and beverage industries), and on calculating the evolution of productivity over the period analysed.
The evolution of productivity was calculated by the variation in the Turnover/Number of Employees ratio between 2008 and 2021.
Table 4 presents the results for the regression models estimated for food and beverage industry.

Table 4. Results of the regression model estimation for food industry and beverage industry

	Food industry				Beverage industry			
	Dependent variable				Dependent variable			
	LN(Prod)		Var_Prod		LN(Prod)		Var_Prod	
Intercept	6.719	***	-1.457	.	6.220	***	0.539	
	(0.455)		(0.744)		(0.724)		(2.972)	
LN(FBCF)	0.273	***	0.119	*	0.340	***	0.020	
	(0.029)		(0.047)		(0.047)		(0.186)	
DF	78		78		59		41	
F-statistic	88.11		6.235		51.27		0.012	
R^2	0.5304		0.074		0.465,		0.0002	
Reset (p-value)	0.011		0.091		0.075			
JB (p-value)	0.0031		< 2.2e-16		1.665e-15			
Breush-Pagan (p-value)	0.2669		0.1479		0.0225			

Notes: For each industry, we estimate two models with different dependent variables: the logarithm pf productivity of respective industry (LN(Prod)) and the variation of productivity (Var_Prod).

Estimation method OLS. The standard error of each parameter is in parentheses. Reset (p-value) refers to the p-value of Reset test for specification, JB (p-value) refers to the p-value of Jarque-Bera test for normality of errors and Breush-Pagan (p-value) refers to the p-value teste for the homoskedasticity test.

Significance codes: *** p< 0.001; ** p< 0.01; * p< 0.05; . p< 0.1

Results of Table 4 show that there is a positive and significant relation between gross fixed capital formation (FBCF) and the productivity of both industries: food and beverage. Regarding the results for food industry, we may see that an increment of 1% in FBCF will promote an increment in productivity of 0.273%. On the other hand, the influence in the variation of productivity is about 0.119.

In what refers to the beverage industry, the model where the dependent variable is the variation of productivity does not present global statistical significance. On this way, we focus on the elasticity model, in which results point to a increment of 0.34% in productivity when FBCF increases 1%.

4. Discussion and final considerations

Between 2007 and 2020, the agri-food industry in the North proposed an overall investment of 1,214.93 M€, which was supported by public spending totalling 453.83 M€. In relative terms, compared to the country's total agri-food industrial sector, these values for the North represent approximately 32.1 per cent of the total value of investment and 34.5 per cent of the total value of public spending in the sector. If we compare this information with that provided in table 2.A (in appendix), which states that in 2021 the North had 29% of the total GVA of the agri-food industry, 32% of the number of companies and 29% of the workforce, we can deduce a greater relative dynamism in the North compared to the rest of the country's agri-food industry companies.

This dynamism has shown a growing trend, with the relative weight of the sector in the Northern region in the total sector at national level increasing significantly between the first period analysed, corresponding to the QREN (2007-2013), and the second period, under the PT2020 (2014-2020). Specifically, the relative weight of investment in this sector in the North of Portugal increased from 29 per cent to 35 per cent.

In terms of the division of the agri-food industry into the food component (CAE10) and the beverage component (CAE 11), as well as by region, the food industries showed greater dynamism with 689.3 M€ of investment and 286.7 M€ of support received and where the NUT IIIs corresponding to Greater Porto and Ave, and later the Metropolitan Area of Porto and Cávado, stood out. The beverage industries absorbed 525.5 M€ and 167 M€ of investment and support, respectively, with great relevance for the NUT III Douro and Porto.

To sum up, cross-referencing the representativeness of the agri-food industry in the North in terms of investment and support (between 32-37%), with the 26.3% relative weight of GFCF declared by companies in 2021, reveals an investment gap that will potentially be of an intangible nature, namely in R&D, increasing innovation, competitiveness and internationalisation, fundamental factors for the competitiveness of the agri-food industry.

We anticipate that shortly, there will be increased access to data at a more granular level. This data will be sourced from the entities responsible for managing EU funds and from official statistical organizations. This data will be available at both regional levels and in terms of the specific industry sectors of companies. This enhanced data availability will facilitate advancements in our analysis of the impact of investments on productivity. Additionally, it may enable us to incorporate other relevant variables into our analysis.

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Appendices

Table 1.A. Indicators for the Northern region and the agri-food industrial sector (2021)

Indicators /Territories	Portugal	Norte	A. Minho	Cávado	Ave	AM Porto	A.Tâmega	T. Sousa	Douro	TT Montes
Socio-economic indicators										
Population density	112.9	169.4	104.6	336.3	289.1	857.1	28.8	223.6	45.7	19.4
Level schooling Upper-secondary (%)	23.5	21.9	21.7	22.9	21.2	22.8	17.6	20.3	19.9	19.9
Resident population (10^3 nº)	10 343	3 587	231	417	418	1 736	84	409	184	107
Ageing index (%)	182.1	184.1	251.9	146.5	167.3	174.7	383.9	149.5	274.4	359
Per capita purchasing power	100	92.9	82.25	91.74	85.65	103.27	73.46	75.93	79.81	81.51
Regional development composite index	100	99.59	98.82	101.36	97.1	103.32	88.63	92.6	88.89	96.5
Company indicators										
Gross value added (10^6 €)	108 914	32 988	1 707	3 886	3 940	18 890	388	2 888	865	424
Gross fixed capital formation ((10^6 €)	22 286	6 399	331	673	752	3 892	67	403	214	66
Total Employees (10^3 No.)	2 287	803	46	101	104	413	11	85	27	15
Agriculture, for. fishing (%)	2.0%	1.0%	1.6%	0.8%	0.8%	0.6%	1.6%	1.0%	6.1%	3.4%
Industry, const., energy and water (%)	30.4%	41.8%	45.5%	49.0%	60.0%	32.8%	33.3%	61.8%	26.7%	23.5%
Services Employees (%)	67.5%	57.2%	52.9%	50.2%	39.3%	66.6%	65.0%	37.3%	67.2%	73.1%
Sector Agroindustrial										
Nº Enterprises total agroindustrial										
Total agroindustrial	11 166	3 540	256	252	346	1 356	166	416	471	277
Manufacture of food products	9 186	2 787	197	211	294	1 178	136	287	226	258
Manufacture of beverages	1 980	753	59	41	52	178	30	129	245	19

Sources: INE (2024a,b,c,d,e,f); MTSSS/GEP (2024) and DGT/MCT-MAE (2024)

Table 2.A. Indicators for agri-food industrial sector and the Northern region (2021)

	Portugal	Norte	North in % Portugal
Gross value added (10^6€)			
Total agroindustrial	3 418	989	29,0%
Manufacture of food products	2 472	557	22,5%
Manufacture of beverages	946	432	45,7%
Gross fixed capital form. (10^6 €)			
Total agroindustrial	718	189	26,3%
Manufacture of food products	496	99	20,0%
Manufacture of beverages	222	90	40,5%
Employees (10^3No.) in enterprises			
Total agroindustrial	103.4	29.9	28.9%
Manufacture of food products	87.1	23.3	26.7%
Manufacture of beverages	16.3	6.6	40.6%

Sources: INE (2024e,f) and MTSSS/GEP (2024).