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The Digitalization of the European Agri-Food Cooperative Sector. Determining Factors to Embrace Information and Communication Technologies

Javier Jorge-Vázquez [1,*], Mª Peana Chivite-Cebolla [1] and Francisco Salinas-Ramos [2]

[1] DEKIS Research Group, Department of Economics, Catholic University of Ávila, 05005 Avila, Spain; mpeana.chivite@ucavila.es
[2] Department of Economics, Catholic University of Ávila, 05005 Avila, Spain; francisco.salinas@ucavila.es
* Correspondence: javier.jorge@ucavila.es

Abstract: The digitization of the agri-food sector is a strategic priority in the political agenda of European institutions. The opportunity to improve the competitiveness and efficiency of the sector offered by new technologies comes together with its potential to face new economic and environmental challenges. This research aims to analyze the level of digitalization of the European agri-food cooperative sector from the construction of a composite synthetic index. Such an index is to be based on a diverse set of variables related to electronic commerce and the services offered through the internet. It also evaluates how European cooperatives influence the degree of technological adoption depending on their size or the wealth of the country where they carry out their activity. The empirical analytical method is thus used, through the analysis of frequencies and correlations. The results obtained reveal the existence of a suboptimal and heterogeneous degree of digitization of European agri-food cooperatives, clearly conditioned by their size and the wealth of the country where they operate. In this situation, it is recommended to promote public policies that guarantee high-performance digital connectivity, an improvement in training in digital skills and the promotion of cooperative integration processes.

Keywords: agroindustrial; agricultural cooperative; technology adoption; technology and competitiveness; information and communication technology; digital transformation; agri-food cooperatives

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1. Introduction

In the last few decades, society has digitalized in a generalized way in most of the developed countries and has also adopted a character of transversality that is encouraging reconsideration of the traditional forms and balances of economic and social organization. This phenomenon is inseparable from the vigorous and accelerated development of new digital technologies.

The vertiginous development of digital infrastructures together with the globalization of an increasingly agile and reliable network access and interconnection is causing a global digital ecosystem. Its configuration drives the concurrence of multiple disruptive processes, with a noticeable incidence in all productive sectors, pushing towards the transformation of business models and the change in economic growth patterns of developed countries. There is no doubt that the digital transformation comes today as a lever that drives development and economic growth while favoring profits in terms of competitiveness and business efficiency.

In this dynamic and highly competitive environment, the European agri-food cooperative sector must undertake a digitalization strategy that allows it to take advantage of the opportunities that arise from a hyperconnected global market such as the current one is. The access new technologies and the implementation of technical and organizational inno-

vations must therefore be a priority for agri-food cooperatives that seek to obtain profits in terms of competitiveness and productivity and thus improve their market positioning.

This research intends to contribute to the study of the degree of implementation of new digital technologies in business organizations and, more particularly, in the European agri-food cooperative sector, which has unquestionable strategic importance for the European Union (EU) [1]. In this way, the main objectives set forth can be defined as two: (i) develop an exploratory study on the degree of digitalization of European agri-food cooperatives based on two specific dimensions of analysis: their presence on the Internet and the use of information and communication technology (ICT) for commercial purposes by evaluating the online sales channels and tools present on their websites; and (ii) identify the determining factors of the digitization index of European agri-food cooperatives, based on two variables: the size of the cooperative societies and the wealth of the country where they carry out their activity.

In order to achieve both objectives, we propose to build a composite index to allow for the development of a comparative analysis of the degree of technological integration of a representative sample composed of 454 EU (28) agri-food cooperatives. Additionally, the analysis of frequencies and correlations will allow for the determination of the degree of influence of the different factors on the digitization index of cooperatives.

The sequence of research is as follows: after defining the scope of research and, once the objectives of the study have been defined, we proceed to develop a brief review of the background of the research around the conditions of the issue that allow us to lay the groundwork to make research assumptions. Once the methodology has been thoroughly defined and the proposed assumptions presented, the analysis and discussion of the results obtained in the investigation, as well as the main conclusions reached, are presented by highlighting the implications of the findings and summarizing directions of ongoing research.

2. Theoretical Framework

Analyzing the economic effects associated with the process of digitalization of the economy has been a common object of interest for the scientific community in recent decades. These investigations have focused on the study of the economic impact of adding new technologies, mainly in three different areas: productivity gains, economic growth and the labor market.

Far from undertaking a systematic review of the literature on the current status, an objective that exceeds the scope and purpose of this research, we present below the main works that highlight the background of the investigation and the current state of knowledge.

The economic literature we reviewed evidences the existence of a large group of works that confirm the significant influence that implementing ICT has on profits in terms of total productivity of productive factors. In particular, Nordhaus [2] attributes the rebound we observed in the average productivity of the business sector since 1995 to the strong growth of productivity in sectors that are intensive in information and communication technologies. Along these lines, Besnaham et al. [3] also conclude that adopting information technologies causes positive effects on business productivity. However, they argue that such productivity increases when combined with certain organizational investments. Hernando et al. [4] also find evidence of a positive and relevant contribution of ICT to the growth of production and productivity in Spain in the period 1991–2000, while Astrostic et al. [5] assert that there is a clear link between information technology and productivity gains. For their part, Draca, M. [6] present a neoclassical framework to understand the role of ICT and productivity. In their study, they find that there is evidence of a strong association between information technologies and firm performance. For his part, Torrent [7] maintains that communication technologies, although they are not the only causal factor, "are consolidated as an essential instrument for the development of production, work and consumption in the network" (p. 19). Cardona et al. [8], after reviewing empirical literature, found that most studies

point out the positive and significant effect of ICTs on productivity, although they argue that research in this field is still insufficient to better understand the externalities of ICTs in the economy. Other research has shown the significantly positive impact on agricultural productivity [9] and that such improvement in agricultural yields associated with the adoption of new technologies has contributed to reducing poverty and food insecurity rates in the most disadvantaged rural areas and, consequently, to economic growth [10]. On the contrary, some authors [11] have found certain limitations and a reduced impact of public programs for easy adoption of technology through extension programs based on ICT in the agricultural field. In any case, most studies coincide in pointing out the positive impact of investment in information technology (IT) on world economic growth, especially in the most industrialized economies and in developing Asian countries [12]. Other works [13,14] have also analyzed the impact of ICTs in Europe, concluding that the deployment and use of ICTs drives economic growth in developed European countries. Additionally, the use of ITC and, in particular, digital empowerment have positive economic effects on the labor market and on the inclusion of disadvantaged groups [15]. This positive impact on the economy responds largely to the improvement of the international competitiveness of companies [16] and the internal efficiency of companies [17]. In particular, some studies have analyzed the positive impact of ITCs on the economic efficiency of companies operating in the agri-food sector [18]. In most of these studies, the main benefits of the use of new technologies are the greater growth, development and economic efficiency of companies [19] by complementing other production factors and promoting innovation by significantly reducing transaction costs [20].

Along these same lines, some works [21] have confirmed that adopting ICT in the agri-food sector, along with other structural and organizational variables, constitutes a relevant factor to be considered in improving competitiveness, gains in economic efficiency and the development of the sector itself, while contributing to sustainability in agriculture and food systems [22].

On the other hand, the existence of conditioning factors to adopt new technologies in the agri-food sector has also been a common object matter of scientific interest.

Most studies on technological adoption in firms are based on the theories of the diffusion of innovation (DOI) and technology, organization and environment (TOE) [23]. In both models, the size of the firm measured by the number of employees is considered one of the determining factors in the adoption of innovation and technology in organizations [24,25]. Along these lines, some research such as that developed by [26] has explored the influence that social and demographic factors, commercial orientation or the size of farms generate in the adoption of information systems based on ICT.

Other studies have found that the level of ICT adoption has higher levels in the richest countries and that the return obtained from such implementation is also higher than in the poorest countries [9].

The studies on digital transformation developed in the field of the agri-food cooperative sector agree to point out the existence of some delay in adopting new technologies for business purposes [27]. Such a delay is conditioned by the size and subsector where cooperatives carry out their activity [28] and by the quality of their website [29]. Ultimately, this makes it difficult to include advanced functions on websites [30] or to take advantage of the opportunities offered by ICTs, such as traceability systems for the agri-food supply chain based on blockchain technology [31], among others.

In several areas and regions, there are still works that present digitization as a solution to the sustainability of agri-food systems around the world. In this regard, there are works that focus on studying the regions of the Middle East and North Africa [32]. In the Barents Region [33], digitalization can create conditions that are necessary to diversify organizational schemes and effectively monitor food processing operations that will help to promote food and nutrition security.

In Spain, for example, research indicates that, although the growing importance of digital communication stands out, Spanish cooperatives still do not invest or include this matter in their strategic plans [34]. For wine cooperatives to be competitive and improve the quality of their website, they will need to improve their digital communication [35]. Domestically, in the Catalonia region, it will be reported that cooperatives in this region continue to show very low levels due to the lack of presence of websites on the internet [36].

Based on the review of the research background and the current status of the issue raised, the following research assumptions are made for subsequent contrast:

Hypothesis 1. *Agri-food cooperatives in the EU (28) have a degree of digitalization below the average level observed in the European business sector as a whole.*

Hypothesis 2. *The size of the agri-food cooperative in the EU (28) constitutes a conditioning factor in the adoption of new technologies.*

Hypothesis 3. *The wealth of the country where the agri-food cooperative develops its activity exerts a significant influence on its degree of digital transformation.*

3. Materials and Methods

In order to comply with the scientific objectives formulated and proceed to contrast the research assumptions raised on the degree of digitalization of the European agri-food cooperative sector, it is proposed to apply the empirical analytical method, through the analysis of frequencies and correlations. To evaluate the website, we will choose the method of accounting and will apply content analysis techniques.

3.1. Population and Sample

The agri-food cooperatives that are active in the EU (28) make the study population of this work. The source used to obtain the European cooperatives operating in the agri-food sector is the Orbis database [37]. For this search, we obtained a total population of 35,384 cooperatives. By including the most updated availability criterion of the reported information as an indicator of business activity and taking cooperatives with data after 2016, the population is 16,184 registered cooperatives.

Once the population under study was identified, the sample size was determined through randomized stratified probabilistic sampling according to the country, for a 95% confidence level and a sampling error of 4.6%. That gave us a sample size of 441.52 cooperatives. Applying stratified random probabilistic sampling according to the country allows everyone to be represented, especially those with the largest number of cooperatives, according to that base, to a greater extent, which allows for an additional inter-territorial analysis.

To determine the sample size for each country, it is established that any countries that have the most cooperatives have up to 24, those that are average have 16, and those with the lowest number or least data availability (5 countries) have between 9 and 5, depending on said availability. Thus, the country with the lowest representation is Luxembourg, holding 5 cooperatives. The sample broken down by countries is distributed as shown in Table 1.

Although the sample came up to 442 cooperatives, 454 have finally been selected to allow greater representation.

Table 1. Sample of cooperatives by EU country (28). Source: Own development.

Country	Cooperative	Country	Cooperative
Austria	16	Italy	24
Belgium	16	Latvia	16
Bulgaria	24	Lithuania	16
Croatia	16	Luxembourg	5
Cyprus	6	Malta	8
CzechRepublic	16	Netherlands	16
Denmark	16	Poland	16
Estonia	16	Portugal	7
Finland	16	Romania	16
France	24	Slovakia	16
Germany	24	Slovenia	9
Greece	16	Spain	24
Hungary	24	Sweden	19
Ireland	16	UK	16
		TOTAL	**454**

3.2. Selection of Variables and Information Sources

The variables considered in this study, collected and described in Table 2, have been selected based on the recommendations provided by the European Parliament and the European Council for producing statistics on the Information Society and, in particular, to gather information related to the characteristics that must be collected from the companies that have a website. Following this recommendation, the taxonomy proposed by [28] has been adopted, insofar as it allows for the categorization of a broad set of parameters on the degree of digital transformation of cooperative societies by evaluating a series of indicators on the use of the internet and other electronic networks and, in particular, on the web services offered and electronic commerce. In turn, for better international comparison of the index of digital transformation of European agri-food cooperatives with other corporate legal forms, we have opted to select those variables included in the "Community survey on ICT usage and e-commerce in enterprises" that Eurostat publishes periodically and that allows one to perform said analysis based on a set of consistent and reliable data.

Table 2. Services offered on the internet and electronic commerce: selected variables. Source: own development based on the "Community survey on ICT usage and e-commerce in enterprises" (Eurostat, several years) and [28].

Category	Variable		Definition
Use of internet and other electronic networks by companies (electronic commerce)	B1	Cooperatives where the website provided online ordering or reservation or booking, e.g., shopping cart.	Regarding the existence of a sales channel through electronic commerce. It evaluates the existence of e-commerce platforms or platforms that allow for the reception of orders, the booking of goods or services through the internet or other telematic networks.
	B2	Cooperatives where the website provided description of goods or services, and price lists.	Refers to the possibility and ease of access, through the website, of catalogs of goods and/or services offered by the cooperative or publication of price rates for its products.
	B3	Cooperatives where the website provided possibilities for visitors to customize or design the products (webctm).	Is related to the inclusion of tools in the buying process that allow the user to personalize and/or take part in the design of the goods and services offered by the cooperative.
	B4	Cooperatives where the website provided order tracking available online.	Provision on the website of platforms or other telematic means that allow for real-time monitoring of the status of processing of the order, from the completion of the online purchase process to the effective delivery of the product to the customer.

Table 2. *Cont.*

Category		Variable	Definition
Quality of website and services offered on the internet	C1	Cooperatives with a website.	Includes the existence of a specific web portal of the cooperative company, as well as its positioning in the Google search engine.
	C2	Corporate presentation of the cooperative entity.	It is related to the publication of sufficient and adequate information about the cooperative entity and its activity.
	C3	Cooperatives with personalized content in the website for regular/repeated visitors (webper).	Is related to the adaptation of the contents and structure of the web based on the observed user's behavior, as well as its specific attributes (profile, location, etc.) in order to offer an improvement in the browsing experience.
	C4	Cooperatives where the website had links or references to the enterprise's social media profiles.	Presence in the corporate web portal of explicit references and links to the main communication platforms to allow interaction and exchange of content and information with suppliers, customers and other agents that are related to the activity of the cooperative.
	C5	Cooperatives where the website provided a private policy statement, a privacy seal or certification related to website safety.	Inclusion in the website of a specific section reserved for the description of the privacy and data protection policy, use of the page and limitations of use, use of cookies, security, etc.
	C6	Cooperatives where the website provided advertisement of open job positions or online job application.	Refers to the use of the website as an electronic means at the service of personnel recruitment processes. It includes elements such as the existence of a job offer board, the availability of a channel enabled for sending CV, etc.
	C7	Cooperatives where the website provided for the electronic submission of complaints.	Existence on the website of a specific channel enabled for the submission of claims or, failing that, the publication on the website of specific instructions for filing claims through other telematic means (for example: via email).
	C8	Adaptive web design.	The website has a "responsive" design, that is, it is optimized to be displayed according to the screen size of the device in use to visit it.

The search and data collection has been carried out in late 2018 and early 2019 through the direct analysis of the content and design of the Web pages corresponding to each of the 454 European agri-food cooperatives that make up the sample under study. In particular, 12 variables total have been verified. Said binary dichotomous variables are decided to be encoded so that they can take the value "1", should it have such attribute, or the value of "0" otherwise.

On the other hand, in order to identify determinants of the degree of digitalization of agri-food cooperatives and thus comply with the objectives formulated, a set of additional variables indicative of the size of the agri-food cooperative society are added: A.0 number of employees/members, A.1 ordinary results before taxes and A.2 total assets.

Finally, in order to determine the ability of the country's wealth to influence in the adoption of new technologies by the agri-food cooperatives under study, it is decided to consider as a measure of such wealth the gross domestic product (GDP) per capita, which is obtained from the statistics published by the World Bank for fiscal year 2018.

3.3. Method

To achieve the proposed scientific objectives and in order to proceed with the contrast of the formulated research assumptions, a combination of the following methods is applied: to evaluate the attributes of the website that are related to electronic commerce and the web services offered, we opted to apply the accounting method adopted in other research

related to the evaluation of websites [38]. This method is based on the verification of a checklist made of a wide set of items that were verified through the application of web content analysis techniques [39,40].

In contrast to assumption 1, we mainly used the empirical analytical method, through the frequency analysis of the main variables shown in Table 2 and the construction of a composite synthetic index. Its purpose is to offer a synthetic and comparable view on the degree of digitalization of agri-food cooperative societies in the different Member States that make up the EU (28) as an equal measure of the different components that make up the following dimensions: electronic commerce, website quality and services offered on the internet.

Thus, in order to measure the degree of digitalization of the agri-food cooperatives that make up the sample, we created the aggregate variable "Level of digitization", defined as the sum of the set of variables "*B*" and "*C*", according to the Formula (1), and shown in Table 2. This aggregate variable can take a maximum value of 12 and a minimum value of 0. This variable is additionally contrasted with another of the variables provided by the European Commission, specifically the digital intensity score for enterprises, as an aggregate of indices.

$$\sum_{i=1}^{4} \sum_{j=1}^{8} \boldsymbol{Bi\ Cj} \quad (1)$$

In contrast to Assumption 2, we added a set of additional variables indicative of the size of the agri-food cooperative. In this phase of the research, the frequency analysis was combined with the correlation analysis between the selected variables.

To test the third assumption, we established the analysis of frequencies broken down by countries, and, in parallel, created a fictitious variable representing the "wealth of the country" measured as GDP per capita, based on data provided by the World Bank to 2018. It is considered that the country's wealth measured as its purchasing and productive capacity, GDP per capita, can be a determining factor in the level of digitalization of cooperatives. To measure this influence, two linear regressions are presented.

4. Discussion of Results

The data and specifications of the models and of the variables that allow for the contrast of the formulated assumptions are presented in this section. The results obtained are set out below in the order in which the assumptions were proposed.

4.1. Benchmarking of the Degree of Digitalization Existing between Agri-Food Cooperatives and All European Companies

Results obtained from the comparative analysis developed to contrast the existence of a greater delay in the digital transformation of agri-food cooperatives with respect to the entire business sector in the EU (28) are thus presented, as formulated in the first research assumption (H1).

The data collected for each of the selected variables as indicators of the degree of business digitalization are shown in Table 3.

The results obtained in this research confirm that, out of the 454 cooperatives that make up the sample under study, only 52.20% of them have an active website. The percentage reduces to 33.5% when excluding any websites that are not designed under a responsive design pattern. These results coincide with the estimates obtained in other studies, such as the study by [41], where it is quantified that on average, 53.41% of all olive oil producers had websites, or [42], which estimates that 43% of cooperatives in the second degree in Spain have a web page, or the research carried out by [43] that concludes that there are few cooperatives that have a web page in the region of the Canary Islands.

Table 3. EU agri-food cooperatives (28) 2018–2019: WEB services and electronic commerce (2019). Source: own development based on the data collected from the research, the community survey on ICT usage and e-commerce in enterprises (Eurostat, several years).

Category		Variable	Total Coop. *. (no.)	Total Coop. (%)	Total Coop. (%)	EU-28 (%) (1)	Differential (%)
Use of internet and other electronic networks by companies (electronic commerce)	B1	Cooperatives where the website provided online ordering or reservation or booking, e.g., shopping cart	**36**	15.19 (2)	7.93	19	−11.07
	B2	Cooperatives where the website provided description of goods or services, price lists	**172**	72.57 (2)	37.89	56	−18.11
	B3	Cooperatives where the website provided possibilities for visitors to customize or design the products (webctm)	**4**	1.69 (2)	0.88	18	−17.12
	B4	Cooperatives where the website provided order tracking available online	**11**	4.64 (2)	2.42	9	−6.58
Quality of website and services offered on the internet	C1	Cooperatives with a website	**237**	52.20 (1)	52.20	77	−24.80
	C2	Corporate presentation of the cooperative entity	**228**	96.20 (2)	50.22	56	−5.78
	C3	Cooperatives with personalized content in the website for regular/repeated visitors (webper)	**71**	29.96 (2)	15.64	58	−42.36
	C4	Cooperatives where the website had links or references to the enterprise's social media profiles	**105**	44.30 (2)	23.13	38	−14.87
	C5	Cooperatives where the website provided a private policy statement, a privacy seal or certification related to website safety	**129**	54.43 (2)	28.41	31 (3)	−2.59
	C6	Cooperatives where the website provided advertisement of open job positions or online job application	**49**	20.68 (2)	10.79	27 (4)	−16.21
	C7	Cooperatives where the website provided for the electronic submission of complaints	**6**	2.53 (2)	1.32	30 (3)	−28.68
	C8	adaptive web design	**152**	64.14 (2)	33.48	n.d.	n.d.

(1) Data on the cooperative companies analyzed total. (2) Data on cooperative companies with webpage total. (*) All enterprises, without financial sector (10 persons employed or more). (3) Latest available data 2014. (4) Latest available data 2016.

Regarding the quality of the website and the services offered, within the cooperative societies having a website, 96.2% prioritize their corporate presentation, whereas 29.6% offer the possibility of website personalization and 44.3% make reference to corporate profiles in social media. Only 20.7% of the agri-food cooperatives use the web as a staff recruitment channel, while few communication channels enabled to file claims are observed. Regarding the dimension of electronic commerce, 72.6% of the cooperatives that have websites offer access to a catalog of products or price lists, while only 15.2% allow for the formalization of online orders through their website. The possibility of product customization and online tracking of orders is barely available on the websites analyzed, confirming the difficulties of the agri-food cooperative sector in the digitalization of sales channels.

If we use the survey on the use of ICTs in companies published annually by Eurostat (several years) and take the values in the selected variables, shown in Table 4, we can see a relatively heterogeneous degree of digitalization between the different countries that make

up the EU (28). Thus, the most developed European countries have better results in each of the items analyzed, and countries such as Netherlands or Finland stand out, compared to other Member States such as Romania or Bulgaria whose business sector has a much poorer level of digitalization.

Table 4. Digitalization of the European business sector (EU28): website functionalities and ecommerce (2018). Source: own development based on Eurostat (several years) and of the data collected in the research.

	Selected Variables **										
Country	**B1**	**B2**	**B3**	**B4**	**C1**	**C1 Coop**	**C3**	**C4**	**C5**	**C6**	**C7**
European Union—(UE-28)	**19**	**56**	**18**	**9**	**77**	**52**	**58**	**38**	**31** [(4)]	**27** [(2)]	**30** [(4)]
Belgium	23	66	23	13	84	**81**	68	45	28 [(5)]	41 [(2)]	32 [(4)]
Bulgaria	14	41	14	9	51	**8**	42	18	17 [(3)]	9 [(2)]	14 [(4)]
Czechia	28	54 [(1)]	23	8	83	**88**	42	32	21 [(4)]	23 [(5)]	39 [(4)]
Denmark	33	66	30	10	96	**88**	68	59	19 [(3)]	47 [(2)]	35 [(4)]
Germany	16	74	16	7	87	**54**	75	35	56 [(5)]	41 [(2)]	41 [(4)]
Estonia	17	76	17	7	78	**25**	76	32	15 [(3)]	20 [(2)]	19 [(4)]
Ireland	29	62	27	12	79	**69**	66	50	43 [(3)]	28 [(2)]	28 [(4)]
Greece	14	42	13	6	65	**38**	44	42	20 [(3)]	17 [(2)]	24 [(4)]
Spain	15	37	14	8	76	**54**	39	37	51 [(3)]	17 [(2)]	19 [(4)]
France	18	58	18	11	69	**58**	60	33	26 [(4)]	22 [(2)]	26 [(4)]
Croatia	14	38	13	7	73	**25**	41	34	29 [(3)]	17 [(2)]	46 [(4)]
Italy	15	32	13	8	71	**50**	35	37	43 [(3)]	10 [(2)]	20 [(4)]
Cyprus	12	71	12	3	71	**33**	71	45	28 [(3)]	23 [(2)]	39 [(4)]
Latvia	9	59	5	3	63	**31**	59	26	13 [(3)]	16 [(2)]	15 [(4)]
Lithuania	20	54	19	13	78	**50**	57	30	29 [(3)]	21 [(2)]	30 [(4)]
Luxembourg	19	64	19	9	83	**80**	66	42	28 [(3)]	35 [(2)]	25 [(4)]
Hungary	20	56	19	9	66	**29**	58	25	14 [(3)]	20 [(2)]	27 [(4)]
Malta	37	78	36	14	82	**38**	80	61	38 [(5)]	35 [(2)]	46 [(4)]
Netherlands	36	79	34	13	94	**81**	82	62	36 [(3)]	57 [(2)]	45 [(4)]
Austria	22	60	21	5	88	**88**	61	42	31 [(5)]	29 [(5)]	36 [(4)]
Poland	14	61	14	9	67	**75**	62	22	32 [(3)]	18 [(2)]	20 [(4)]
Portugal	10	43	10	7	63	**100**	47	32	28 [(3)]	16 [(2)]	22 [(4)]
Romania	19	42	18	10	44	**25**	43	17	7 [(5)]	10 [(5)]	14 [(4)]
Slovenia	16	81	16	6	84	**38**	81	34	31 [(3)]	27 [(2)]	32 [(4)]
Slovakia	23	68	23	9	76	**67**	69	24	24 [(3)]	26 [(2)]	25 [(4)]
Finland	26	85	25	10	96	**69**	86	68	22 [(3)]	42 [(2)]	53 [(4)]
Sweden	36	48	32	9	92	**21**	51	54	24 [(5)]	na	60 [(4)]
United Kingdom	21	58	20	9	82	**69**	59	51	38 [(5)]	na	33 [(4)]

All enterprises, without financial sector (10 persons employed or more) ** See correspondence of variables (Table 2); na: not available; [(1)] data relating to the year 2017; [(2)] data relating to the year 2016; [(3)] data relating to the year 2015; [(4)] data relating to the year 2014; and [(5)] data relating to the year 2013. B1 Cooperatives where the website provided online ordering or reservation or booking. B2 Cooperatives where the website provided description of goods or services, and price lists. B3 Cooperatives where the website provided possibilities for visitors to customize or design the products (webctm). B4 Cooperatives where the website provided order tracking available online. C1 Cooperatives with a website. C2 Corporate presentation of the cooperative entity. C3 Cooperatives with personalized content on the website for regular/repeated visitors. C4 Cooperatives where the website had links or references to the enterprise's social media profiles. C5 Cooperatives where the website provided a private policy statement, a privacy seal or certification related to website safety. C6 Cooperatives where the website provided advertisement of open job positions or online job application. C7 Cooperatives where the website provided for the electronic submission of complaints.

Additionally, the variable "C1coop" has been included in Table 4. It is noteworthy that the percentage of cooperatives with a website is, in general, lower than that in the business group (C1) for 90% of European countries. If we exclude Portugal, which is atypical in the selection of the sample, it is worth highlighting the cases of Poland and the Czech Republic as the only countries that have a higher percentage of website availability in cooperatives compared to the business sector in their country.

To complete the information and in order to develop a benchmarking that allows for a contrast to assumption 1, the data provided by Eurostat (several years) is used in the "Community survey on ICT usage and e-commerce in enterprises", from which we extracted the data that are most directly related to the variables selected and analyzed for the particular case of agri-food cooperatives in Europe. The results of this benchmarking are presented synthesized in Table 3 and clearly confirm assumption 1—that is, the degree of digitalization of the European agri-food cooperative sector is much lower than that observed in all European companies, which indicates the existence of certain delay in the adoption of ICT by the cooperative societies analyzed. This finding is consistent with results in the literature on the delay with which cooperatives embrace ICTs [28,29,41].

This statement is proven by verifying that the agri-food cooperatives have worse results in all the indicators on the level of digital transformation selected. What is especially striking is the differential in parameters such as the possibility of personalization and availability of the website or in the dimension of electronic commerce in the access to product catalogs or price lists.

On the other hand, in order to build a composite synthetic index that allows for the characterization of the degree of digitalization achieved by agri-food cooperative societies, we have created the aggregate variable "Level of digitization", defined as the sum of the set of variables "B, C" listed in Table 2. This aggregate variable can take a maximum value of 12 and a minimum value of 0. Table 5 shows the results obtained, globally and itemized by countries. Each column indicates the score that can be obtained, from 0 to 12, and for each country the cooperatives that have reached those scores. The highest score, 11, is obtained by a cooperative in Denmark.

Table 5. "Level of digitization" * for European agri-food cooperatives EU (28). 2018–2019. Source: Own development.

Country	0	1	2	3	4	5	6	7	8	9	10	11	12	Average	Total
Austria	2	0	0	1	1	5	4	3	0	0	0	0	0	**4.81**	16
Belgium	3	0	2	1	1	2	2	3	1	1	0	0	0	**4.44**	16
Bulgaria	22	0	0	0	1	0	1	0	0	0	0	0	0	**0.42**	24
Croatia	12	0	0	2	1	1	0	0	0	0	0	0	0	**0.94**	16
Cyprus	4	0	1	1	0	0	0	0	0	0	0	0	0	**0.83**	6
Czechia	2	1	6	3	3	0	0	0	1	0	0	0	0	**2.63**	16
Denmark	2	0	4	1	3	0	2	2	0	1	0	1	0	**4.31**	16
Estonia	12	0	0	2	1	0	1	0	0	0	0	0	0	**1.00**	16
Finland	5	0	1	2	2	1	1	2	2	0	0	0	0	**3.56**	16
France	10	0	0	1	2	4	3	2	2	0	0	0	0	**3.29**	24
Germany	11	0	0	0	2	2	3	2	2	2	0	0	0	**3.50**	24
Greece	10	0	0	0	3	1	1	1	0	0	0	0	0	**1.88**	16
Hungary	17	0	0	2	3	1	1	0	0	0	0	0	0	**1.21**	24
Ireland	5	0	0	2	2	2	2	3	0	0	0	0	0	**3.56**	16
Italy	12	0	0	1	0	2	5	2	2	0	0	0	0	**3.04**	24
Latvia	11	0	0	1	1	1	2	0	0	0	0	0	0	**1.50**	16
Lithuania	8	0	1	1	2	2	1	1	0	0	0	0	0	**2.25**	16
Luxembourg	1	0	1	0	1	1	0	0	0	0	1	0	0	**4.20**	5
Malta	5	0	2	1	0	0	0	0	0	0	0	0	0	**0.88**	8
Netherlands	3	0	0	2	1	2	2	2	2	2	0	0	0	**5.00**	16
Poland	4	0	0	4	2	5	0	0	0	0	1	0	0	**3.44**	16
Portugal	0	0	1	0	1	1	0	1	3	0	0	0	0	**6.00**	7
Romania	12	1	0	0	0	2	1	0	0	0	0	0	0	**1.06**	16
Slovakia	10	1	2	0	1	0	0	0	2	0	0	0	0	**1.56**	16
Slovenia	3	0	2	0	1	2	0	1	0	0	0	0	0	**2.78**	9
Spain	11	0	1	2	5	3	1	0	0	1	0	0	0	**2.42**	24
Sweden	15	0	0	1	1	0	0	1	0	1	0	0	0	**1.21**	19
United Kingdom	5	0	0	0	1	3	1	2	3	0	1	0	0	**4.56**	16
European Union (EU28)	**217**	**3**	**24**	**31**	**42**	**43**	**34**	**28**	**20**	**8**	**3**	**1**	**0**	**2.64**	**454**

* "Level of digitization", defined as the sum of the set of variables "B, C" shown in Table 2.

On the other hand, it is interesting to verify that only two countries would reach an "approved" digitization index, with at least a 5-point average rating. It should be noted that as for one of them, the case of Portugal is atypical, since we only considered the 7 cooperatives reported by the database consulted, and all of them had a web page. The average for the EU is 2.64.

If we turn to the European Commission (EC) and, in particular, the index on digitalization that it designs to measure such transformation (DESI), it brings together the results achieved according to 4 different levels, as shown in Table 6.

Table 6. Digital intensity score for enterprises [(1)] (2018) EU (28) and aggregate variable "Level of digitization" for agri-food cooperatives EU (28) clustered (2018–2019). Measure: percentage (%). Source: Own development based on data from the study and the EC Economy and Digital Society index available at: https://digital-agenda-data.eu/datasets/desi/visualizations (accessed on 20 August 2019).

Country		Very Low (0–3)		Low (4–6)		High (7–9)		Very High (10–12)	
		Enter [(2,3)]	COOP	Enter [(2,3)]	COOP	Enter [(2,3)]	COOP	Enter [(2,3)]	COOP
Austria	AT	40.73	18.75	42.52	62.50	14.52	18.75	2.23	0.00
Belgium	BE	32.81	37.50	39.64	31.25	22.07	31.25	5.48	0.00
Bulgaria	BG	66.62	91.67	24.82	8.33	7.81	0.00	0.74	0.00
Croatia	HR	50.92	87.50	33.55	12.50	13.64	0.00	1.89	0.00
Cyprus	CY	44.47	100.00	40.97	0.00	13.26	0.00	1.3	0.00
Czechia	CZ	48.03	75.00	34.94	18.75	14.27	6.25	2.76	0.00
Denmark	DK	13.51	43.75	37.01	31.25	38.29	18.75	11.19	6.25
Estonia	EE	41.88	87.50	37.67	12.50	17.23	0.00	3.22	0.00
European Union	**EU**	**45.84**	**60.57**	**36.2**	**26.21**	**15.88**	**12.33**	**2.08**	**0.88**
Finland	FI	11.12	50.00	39.58	25.00	37.57	25.00	11.73	0.00
France	FR	50.28	45.83	34.88	37.50	13.4	16.67	1.44	0.00
Germany	DE	41.36	45.83	42.29	29.17	15.2	25.00	1.16	0.00
Greece	EL	59.77	62.50	30.56	31.25	8.76	6.25	0.91	0.00
Hungary	HU	54.77	79.17	30.21	20.83	13.06	0.00	1.95	0.00
Ireland	IE	33.89	43.75	37.57	37.50	25.44	18.75	3.1	0.00
Italy	IT	54.6	54.17	31.48	29.17	12.55	16.67	1.36	0.00
Latvia	LV	58.26	75.00	32.18	25.00	9.33	0.00	0.23	0.00
Lithuania	LT	32.7	62.50	40.87	31.25	21.16	6.25	5.27	0.00
Luxembourg	LU	38.21	40.00	41.43	40.00	19.04	0.00	1.32	20.00
Malta	MT	28.86	100.00	39.19	0.00	26.83	0.00	5.12	0.00
Netherlands	NL	21.18	31.25	41.75	31.25	32.4	37.50	4.67	0.00
Poland	PL	56.25	50.00	31.34	43.75	10.96	0.00	1.45	6.25
Portugal	PT	51.13	14.29	33.1	28.57	14.4	57.14	1.38	0.00
Romania	RO	60.52	81.25	28	18.75	10.29	0.00	1.18	0.00
Slovakia	SK	51.59	81.25	35.39	6.25	11.84	12.50	1.18	0.00
Slovenia	SI	31.62	55.56	41.64	33.33	23.42	11.11	3.32	0.00
Spain	ES	56.81	58.33	30.16	37.50	11.96	4.17	1.08	0.00
Sweden	SE	21.84	84.21	37.13	5.26	33.04	10.53	7.99	0.00
United Kingdom	UK	38.38	31.25	39.91	31.25	19.35	31.25	2.35	6.25

[(1)] The digital intensity score is based on counting how many out of 12 technologies are used by each enterprise. Then they are divided into four clusters of digital intensity: Very Low (scores 0–3), Low (score 4–6), High (score 7–9) and Very High (score 10–12). [(2)] "The 2015 list of technologies includes: usage of internet by a majority of the workers; access to ICT specialist skills; fixed broadband speed >30 Mbps; mobile devices used by more than 20% of employed persons; has a website; has some sophisticated functions on the website; presence on social media; does e-sales for at least 1% of turnover; exploit the B2C opportunities of web sales; use an ERP software; use a CRM software; share electronically supply chain management information." [(3)] Percentage of enterprises (all sectors).

Similarly, as the EC did, the cooperatives were classified according to the scores obtained but according to the index created for this research. Although it is true that the number of variables included in the DESI index was greater, it can be verified that the trend analyzed was maintained. Thus, whereas companies in general within the EU (28) had a Very Low level at 45.84% of the companies, cooperatives had a higher level at 60.57%. For the Low level, it was 36.20% compared to 26.21% in cooperatives, and in High and Very

High, compared to 15.88% and 2.08%, respectively, in cooperatives, it remained at 12.33% and 0.88%.

4.2. Influence of the Variables Size and Wealth of the Country on the Digital Transformation of Agri-Food Cooperatives

In order to contrast the second and third assumptions and verify whether the variables size and wealth of the country exert some influence on the degree of digital transformation of the agri-food cooperatives, we carried out the corresponding correlation analysis and collected it in the following tables. Additionally, an inter-territorial analysis was included to complete the analysis. However, given that the sample by country was not high in this aspect, Table 1 was left for future research to elaborate on this line.

As Table 7 shows, there is a high correlation between the aggregate variable, which measured the level of digitization of European agri-food cooperatives, and the variables proposed to measure the size of the cooperative, such as the number of employees/members, the ordinary results before taxes, or total assets, which leads one to confirm the existence of a correlation between the size of the cooperative and the level of digitalization thereof. Along the same lines, other studies [44] have assessed the influence of firm size, corporate website quality and outsourcing of ICT management on organizational performance in the agri-food cooperative sector measured in terms of efficiency. The results obtained also point to the existence of a direct relationship.

Table 7. Correlations of Spearman Agri-food Coop EU (28). Source: own development.

		V ADDED (1)	GDP PER CAPT (2)	C1 Cooperatives with a Website (3)	Number of Employees Last Year Available (4)	Ordinary Results before Taxes Thousand EUR Last Year Available (5)	Total Assets Thousand EUR Last Year Available (6)
(1)	Correlation coefficient	1.000	0.326 **	0.918 **	0.505 **	0.300 **	**0.570** **
	Next (bilateral)		0.000	0.000	0.000	0.000	0.000
	N		454	454	333	353	385
(2)	Correlation coefficient		1.000	0.284 **	−0.011	0.101	0.270 **
	Next (bilateral)			0.000	0.847	0.057	0.000
	N			454	333	353	385
(3)	Correlation coefficient			1.000	0.461 **	0.277 **	**0.534** **
	Next (bilateral)				0.000	0.000	0.000
	N				333	353	385
(4)	Correlation coefficient				1.000	0.453 **	**0.778** **
	Next (bilateral)					0.000	0.000
	N					272	292
(5)	Correlation coefficient					1.000	**0.565** **
	Next (bilateral)						0.000
	N						353
(6)	Correlation coefficient						1.000

** Correlation is significant at the 0.01 level (bilateral).

On the other hand, it is also verified that there is a correlation between the country's GDP per capita and the level of digitalization, confirming in the same way that greater wealth meets greater digitalization.

To complete the study, it includes, in a complementary way, an assessment of the influence and significance level of the different variables analyzed on the level of digitalization of cooperatives through linear regression. Specifically, the following expressions are proposed:

$$\text{V ADDED} = \beta o + \beta_1 \text{ GDP} + \beta_2 \text{ Assets} + \varepsilon \text{ (Model A)} \quad (2)$$

$$\text{V ADDED} = \beta o + \beta_1 \text{ GDP} + \beta_2 \text{ Ord Results} + \beta_3 \text{ no. of employees} + \varepsilon \text{ (Model B)} \quad (3)$$

Due to a very high correlation between assets, ordinary results and number of employees, they cannot be entered in the same regression. However, in order to see the influence

on the aggregate variable, as a measure of the digital transformation of cooperatives, it may be of interest, and hence they are separated into two regressions.

Regarding the level of digitalization of agri-food cooperatives in the EU (28), Tables 8 and 9 show how the variables size of the cooperative, as well as the wealth of the country, measured as GDP per capita, influence their transformation. However, it cannot explain, to a large extent, (R2), such a transformation, but it certainly affects it, as it seemed when analyzing the correlations.

Table 8. Descriptive statistics (a). Source: own development.

	Average	Dev. Deviation	N
V ADDED	2.75	2.98	385
GDP PER CAPT	30,888	17,083.97	385
Total assets thousand EUR Last year available	58,625	287,367.38	385

Table 9. Model A coefficients Source: own development.

	Coef.	T	Next
(Constant)		3.00	**0.00**
GDP PER CAPT	0.33	6.94	**0.00**
Total assets thousand EUR Last year available	0.20	4.33	**0.00**
N		385	
R-sq (R2)		0.169	
Ad, RSq		0.165	
F		39.099	
(P-F)		0.000	

Should the second regression be checked, the results are similar, as shown in Tables 10 and 11, although the explanatory capacity of the model would increase somewhat.

Table 10. Descriptive statistics (b). Source: own development.

	Average	Dev. Deviation	N
V ADDED	3.01	3.051	272
GDP PER CAPT	30,087	16,192.51	272
Ordinary results before taxes thousand EUR Last year available	1420	9986.14	272
Number of employees Last year available	185.01	719.44	272

Table 11. Model B coefficients. Source: own development.

	Coef.	T	Next
(Constant)		1.03	**0.30**
GDP PER CAPT	0.44	8.31	**0.00**
Ordinary results before taxes thousand EUR Last year available	0.14	2.50	**0.01**
Number of employees Last year available	0.14	2.61	**0.01**
N		272.000	
R-sq (R2)		0.291	
Ad, RSq		0.283	
F		36.645	
(P-F)		0.000	

Again, one can check that the proposed model B shows again significance in the influence of the size of the cooperative, as well as of the country's wealth does in the level of digital transformation of the cooperative. In the latter case, the model has some more explanatory capacity.

5. Conclusions

The analysis of the processes of digitalization of business structures constitutes an indisputable element of interest as a catalyst phenomenon of a set of disruptive processes that lead to profit in terms of efficiency, productivity and business competitiveness. The agri-food sector, as a strategic sector of the European productive model, cannot be left out of this opportunity. On the contrary, the adoption of ICT offers competitive advantages by improving the productive yields of the sector while promoting the development of more sustainable, efficient and safe production models.

This research is based on three main research hypotheses that, after being contrasted, were all accepted. In the first place, considering Hypothesis 1, the degree of development of the level of digitization of European agri-food cooperatives is in general terms suboptimal, which entails the existence of a certain "technological backwardness". We can observe said deficiency in technological adoption by cooperatives applied to electronic commerce and services offered on the Internet. Such deficiency is even greater when compared with the data relating to the whole of the European business net. All the indicators analyzed on the degree of digital transformation show worse results in the cooperative agri-food sector. This is also confirmed by the synthetic index "digitization level" constructed in this research. The results obtained in this digitization index show an extremely low average score for European agri-food cooperatives, in particular 2.64 out of 12 points. Second, according to Hypothesis 2, the size of the cooperative is determining for the degree of digitization of European agri-food cooperatives. Thus, those cooperatives that have greater size or volume of resources clearly present a higher level of digitization in the two dimensions of analysis observed: electronic commerce and web services offered. We can also say that the level of digitization has a positive influence on size. There is a similar correlation between the benefit of the cooperative and digitization, and although it has been interpreted in one sense, the analysis could be done in the opposite direction, concluding that the greater the digitization, the greater the benefit, size and therefore growth. In this context, we need to adopt policies that promote cooperative integration processes to allow cooperatives to increase their size and thus improve the conditions for better adopting technology. Third, the contrast of hypothesis 3 allows us to affirm the significant influence of the country's wealth on the degree of digital transformation of the cooperatives under study. From a territorial point of view, the analysis carried out confirms that there has been a very uneven digital transformation among the EU Member States (28) and, in particular, that new technologies are more frequently adopted by cooperatives whose activity develops in territories with greater wealth per capita.

This research has revealed the deficient degree of digital transformation of the European agri-food cooperative sector. Additionally, there is an urgent need to promote public policies that encourage greater adoption of technology in the sector to improve levels of competitiveness, productivity and efficiency. To this end, European public administrations are encouraged to guarantee high-performance digital connectivity in rural areas where the agri-food industry is mostly located. Additionally, promoting training programs in digital skills and information on existing technologies that could be applied to production processes and marketing channels is important. This would allow for a greater dynamism of electronic commerce and an increase in the number of services offered on the internet by agri-food cooperatives. It would also make it possible to face new challenges such as the digitization of the value chain or the integration of new technologies such as artificial intelligence (AI), blockchain, robotics or the internet of things (IoT). In short, the digitization of the agri-food cooperative sector offers a real opportunity to reshape the functioning of

the agri-food markets and respond to the economic and environmental challenges facing the sector.

However, we are aware of the limitations of the study, since there are factors that have not been studied in depth. Among them, it is recommended, for future work, to analyze the type of cooperatives, the different subsectors and the greatest need or convenience of digitization, according to the specific circumstances of each cooperative. These efforts could help focus the efforts of institutions on more efficient digitization.

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References

1. Colom Gorgues, A.; Cos Sánchez, P.; Florensa Guiu, R.M. Cooperativismo agroalimentario en Europa. Dimensión, gobernanza y análisis BCG de las sociedades cooperativas TOP25 de la UE-28 y TOP10 en España. *REVESCO. Rev. Estud. Coop.* **2019**, *130*, 73–98. [CrossRef]
2. Nordhaus, W.D. Productivity growth and the new economy. *Brook. Pap. Econ. Act.* **2002**, *33*, 211–265. [CrossRef]
3. Bresnahan, T.F.; Brynjolfsson, E.; Hitt, L.M. Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence. *Q. J. Econ.* **2002**, *117*, 339–376. [CrossRef]
4. Hernando, I.; Nuñez, S. The Contribution of ICT to Economic Activity: A Growth Accounting Exercise with Spanish Firm-level Data. *Investig. Econ.* **2004**, *28*, 315–348.
5. Atrostic, B.K.; Nguyen, S.V. IT and Productivity in U.S. Manufacturing: Do Computer Networks Matter? *Econ. Inq.* **2005**, *43*, 493–506. [CrossRef]
6. Draca, M.; Sadun, R.; Van Reenen, J. Productivity and ICTs: A Review of the Evidence. In *The Oxford Handbook of Information and Communication Technologies*; Mansell, R., Ed.; Oxford University Press: Oxford, UK, 2007; pp. 100–147.
7. Torrent, J. *La Empresa red. Tecnologías de la Información y la Comunicación, Productividad y Competitividad*; Ariel: Barcelona, Spain, 2008.
8. Cardona, M.; Kretschmer, T.; Strobel, T. ICT and productivity: Conclusions from the empirical literature. *Inf. Econ. Policy* **2013**, *25*, 109–125. [CrossRef]
9. Lio, M.; Liu, M.-C. ICT and agricultural productivity: Evidence from cross-country data. *Agric. Econ.* **2006**, *34*, 221–228. [CrossRef]
10. Minten, B.; Barrett, C.B. Agricultural Technology, Productivity, and Poverty in Madagascar. *World Dev.* **2008**, *36*, 797–822. [CrossRef]
11. Aker, J.C. Dial "A" for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries. *Agric. Econ.* **2011**, *42*, 631–647. [CrossRef]
12. Jorgenson, D.W.; Vu, K. Information Technology and the World Growth Resurgence. *Ger. Econ. Rev.* **2007**, *8*, 125–145. [CrossRef]
13. Fernández-Portillo, A.; Almodóvar-González, M.; Hernández-Mogollón, R. Impact of ICT development on economic growth. A study of OECD European union countries. *Technol. Soc.* **2020**, *63*, 101420. [CrossRef]
14. Hanclova, J.; Doucek, P.; Fischer, J.; Vltavska, K. Does ict capital affect economic growth in the EU-15 and EU-12 countries? *J. Bus. Econ. Manag.* **2014**, *16*, 387–406. [CrossRef]
15. Evangelista, R.; Guerrieri, P.; Meliciani, V. The economic impact of digital technologies in Europe. *Econ. Innov. New Technol.* **2014**, *23*, 802–824. [CrossRef]
16. Peña-Vinces, J.C.; Cepeda-Carrión, G.; Chin, W.W. Effect of ITC on the international competitiveness of firms. *Manag. Decis.* **2012**, *50*, 1045–1061. [CrossRef]
17. García, E.; Rialp, A.; Rialp, J. Tecnologías de la información y comunicación (TIC) y crecimiento de la empresa. Infor-mación Comercial Española. *ICE. Rev. de Econ.* **2007**, *838*, 125–145.
18. Bernal-Jurado, E.; Mozas-Moral, A.; Fernández-Uclés, D.; Medina-Viruel, M. Determining Factors for Economic Efficiency in the Organic Olive Oil Sector. *Sustainability* **2017**, *9*, 784. [CrossRef]

19. Fernández-Uclés, D.; Elfkih, S.; Mozas-Moral, A.; Bernal-Jurado, E.; Medina-Viruel, M.J.; Ben Abdallah, S. Economic Efficiency in the Tunisian Olive Oil Sector. *Agriculture* **2020**, *10*, 391. [CrossRef]
20. Deichmann, U.; Goyal, A.; Mishra, D. Will digital technologies transform agriculture in developing countries? *Agric. Econ.* **2016**, *47*, 21–33. [CrossRef]
21. Bernal-Jurado, E.; Mozas-Moral, A.; Medina-Viruel, M.; Fernández-Uclés, D. Evaluation of Corporate Websites and Their Influence on the Performance of Olive Oil Companies. *Sustainability* **2018**, *10*, 1274. [CrossRef]
22. El Bilali, H.; Allahyari, M.S. Transition towards sustainability in agriculture and food systems: Role of information and communication technologies. *Inf. Process. Agric.* **2018**, *5*, 456–464. [CrossRef]
23. Kossaï, M.; De Souza, M.L.L.; Ben Zaied, Y.; Nguyen, P. Determinants of the Adoption of Information and Communication Technologies (ICTs): The Case of Tunisian Electrical and Electronics Sector. *J. Knowl. Econ.* **2019**, *11*, 845–864. [CrossRef]
24. Drazin, R. The processes of technological innovation. *J. Technol. Transfer.* **1991**, *16*, 45–46. [CrossRef]
25. Rogers, E.M. *Diffusion of Innovations*, 4th ed.; EEUU; Free Press: New York, NY, USA, 1995.
26. Ali, J. Factors Affecting the Adoption of Information and Communication Technologies (ICTs) for Farming Decisions. *J. Agric. Food Inf.* **2012**, *13*, 78–96. [CrossRef]
27. Cristobal-Fransi, E.; Montegut-Salla, Y.; Ferrer-Rosell, B.; Daries, N. Rural cooperatives in the digital age: An analysis of the Internet presence and degree of maturity of agri-food cooperatives' e-commerce. *J. Rural. Stud.* **2020**, *74*, 55–66. [CrossRef]
28. Jorge-Vázquez, J.; Chivite-Cebolla, M.P.; Salinas-Ramos, F. La transformación digital en el sector cooperativo agroalimentario español: Situación y perspectivas. *CIRIEC-Esp. Rev. Econ. Pública Soc. Coop.* **2019**, *95*, 39–70. [CrossRef]
29. Bernal-Jurado, E.; Mozas-Moral, A.; Fernández-Uclés, D.; Medina-Viruel, M.; Poyatos, R.P. Calidad de los sitios web en el sector agroalimentario ecológico y sus factores explicativos: El papel del cooperativismo. *CIRIEC-Esp. Rev. Econ. Pública Soc. Coop.* **2019**, *95*, 95–118. [CrossRef]
30. Fernández-Uclés, D.; Bernal-Jurado, E.; Medina-Viruel, M.; Mozas-Moral, A. El sector cooperativo oleícolas y el uso de las TIC: Un estudio comparativo respecto a otras formas jurídicas. *REVESCO. Rev. Estud. Coop.* **2016**, *120*, 53–75. [CrossRef]
31. Borrero, J.D. Sistema de trazabilidad de la cadena de suministro agroalimentario para cooperativas de frutas y hortalizas basado en la tecnología Blockchain. *CIRIEC-Esp. Rev. Econ. Pública Soc. Coop.* **2019**, *95*, 71–94. [CrossRef]
32. Bahn, R.; Yehya, A.; Zurayk, R. Digitalization for Sustainable Agri-Food Systems: Potential, Status, and Risks for the MENA Region. *Sustainability* **2021**, *13*, 3223. [CrossRef]
33. Raheem, D.; Shishaev, M.; Dikovitsky, V. Food System Digitalization as a Means to Promote Food and Nutrition Security in the Barents Region. *Agriculture* **2019**, *9*, 168. [CrossRef]
34. Dueñas, P.P.M.; Carmona, D.G. La gestión de la comunicación digital en las cooperativas españolas. *CIRIEC-Esp. Rev. Econ. Pública Soc. Coop.* **2021**, *101*, 193–225. [CrossRef]
35. Bernal-Jurado, E.; Mozas-Moral, A.; Fernández-Uclés, D.; Medina-Viruel, M.J. Online popularity as a development factor for cooperatives in the winegrowing sector. *J. Bus. Res.* **2021**, *123*, 79–85. [CrossRef]
36. Araujo, A.; Serrano, E.; Jordan, V. La presencia de las cooperativas de Catalunya en Internet. *CIRIEC-Esp. Rev. Econ. Pública Soc. Coop.* **2020**, *99*, 37–56. [CrossRef]
37. ORBIS. Detailed Information on Companies, Several Years. *BvD (Bureau van Dijk)*. Available online: https://www.informa.es/en/business-risk/sabi/orbis (accessed on 23 March 2019).
38. Law, R.; Qi, S.; Buhalis, D. Progress in tourism management: A review of website evaluation in tourism research. *Tour. Manag.* **2010**, *31*, 297–313. [CrossRef]
39. McMillan, S.J. The Microscope and the Moving Target: The Challenge of Applying Content Analysis to the World Wide Web. *J. Mass Commun. Q.* **2000**, *77*, 80–98. [CrossRef]
40. Weare, C.; Lin, W.-Y. Content Analysis of the World Wide Web: Opportunities and Challenges. *Soc. Sci. Comput. Rev.* **2000**, *18*, 272–292. [CrossRef]
41. Fernández-Uclés, D.; Bernal-Jurado, E.; Mozas-Moral, A.; Medina-Viruel, M.J. The importance of websites for organic agri-food producers. *Econ. Res. Ekon. Istraž.* **2019**, *33*, 2867–2880. [CrossRef]
42. Bernal-Jurado, E.; Mozas-Moral, A. Evaluación del uso comercial de la World Wide Web por parte de las cooperativas de segundo grado españolas. *Rev. Esp. Estud. Agrosoc. Pesq.* **2008**, *219*, 181–200.
43. González-Aponcio, Z. Determinantes de la calidad de la información divulgada vía Web por las pequeñas y medianas cooperativas de Canarias. *REVESCO. Rev. Estud. Coop.* **2020**, *133*, 1–15. [CrossRef]
44. Cristóba-Fransi, E.; Montegut-Salla, Y.; Daries-Ramon, N. Cooperativismo 2.0: Presencia en Internet y desarrollo del comercio electrónico en las cooperativas oleícolas de Cataluña. *REVESCO. Rev. Estud. Coop.* **2017**, *124*, 47–73. [CrossRef]