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Editorial

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The Volume 24, Issue 2 of *Economia agro-alimentare/Food Economy*, features four Special Issue articles, two regular Articles and one Note, all written in English. The articles mainly cover issues related to the impact of the Covid-19 pandemic on the agri-food system, which was the focus of the 29th SIEA Annual Conference "#foodrestart-Brexit, New CAP, Covid-19: Italian agribusiness restarts", held in Verona (Italy), on Sep. 30-Oct. 1, 2021. Manuscript editing for these papers has been curated by the Guest Editors, Roberta Capitello and Diego Begalli. We are happy to host these contributions, which shed light on the consequences of the global pandemic on the Italian agri-food system, and help show the way towards recovery of the food economy. The other two papers deal with functional food in Portugal, Participatory Guarantee Systems in Italy, and a commentary on the peer-review process.

The range of the analysis goes from local to global and covers geographical areas in Italy and Portugal.

The authors are affiliated with Institutions based in Italy, Portugal, and Brazil.

The 29th Annual Conference of the Società Italiana di Economia Agro-alimentare (SIEA - Italian Association of Agri-Food Economics) took place in Verona (Italy) on Sep. 30-Oct. 1, 2021. More than 90 delegates, including food economists and agri-food professionals, attended the conference. The contributions focused on the rapid and profound changes affecting national agri-food systems. The disruptive event of the Covid-19 pandemic, on the one hand, and the continuous challenges of sustainable development goals, international business competitiveness, and European Union policy, on the other one hand, are not only implying new adaptation and resilience processes to the Italian agri-food producers but also modifying their perspective view of the environment, the society and consumer demand. A plenary session, fifteen research contributions, an international workshop on sustainable food consumption, and two round tables with agri-food professionals have animated two intensive days of communications and discussions.

A selection of four studies presented during the conference has been accepted as featured articles for this issue of *Economia Agro-alimentare/ Food Economy*. The guest editors Roberta Capitello and Diego Begalli would like to express their sincere gratitude to the reviewers involved in the manuscript peer review process for their valuable feedback and assistance.

These studies analyse the Italian agri-food system from four different angles: the circular economy, retailer supply of sustainable food, food consumer preferences, and transaction costs. They are complementary in dealing with sustainability and the Covid-19 impact on the agri-food supply chain and offer interesting new perspectives on these current, relevant topics.

Giulia Maesano, Manal Hamam, Biagio Pecorino, Gioacchino Pappalardo, Mario D'Amico and Gaetano Chinnici co-author the article "Trends in consumers' preferences towards fresh-cut vegetables during the Covid-19 pandemic". This study started from the observation that the fresh-cut vegetable industry in Italy recorded a negative trend during the period of Covid-19 lockdown. To know more about the causes of this phenomenon, the authors propose a market analysis in Sicily (Italy) involving a sample of 427 consumers. The study analyses the role played by the different attributes in driving consumer purchasing behaviour of fresh-cut vegetable products during the Covid-19 lockdown. Information has been collected through an online questionnaire and then analysed using bivariate and multivariate statistics to evaluate the significance of product attributes in consumer preferences and detect consumer preference heterogeneity. The authors highlight that some fresh-cut vegetable attributes, such as taste, appearance and nutritional contents, together with convenience, are still

relevant purchasing factors for consumers. However, during the Covid-19 lockdown, the difficulty in food procurement, the fear of contagion during purchasing, and higher prices have obliged consumers to change their habits. Three market segments have been identified. They depict the different attitudes that drive consumers in choosing fresh-cut vegetables: pragmatism, highlighting the search for affordability and safety; healthiness, for those consumers focusing on intrinsic cues and convenience (i.e., easy to use and time-saving); scepticism, towards the real benefits that these products can bring to consumers, that conversely represents a barrier to purchase. This article will contribute to increasing the reader's knowledge of consumer preferences for this under-studied type of product. Moreover, it will improve the understanding of how the Covid-19 pandemic, acting as an exogenous factor, has combined temporary effects with long-term changes to consumer preferences.

In the article "The Circular Economy in the Agri-food System: A Performance Measurement of European Countries", Brunella Arru, Roberto Furesi, Pietro Pulina, Paola Sau, and Fabio A. Madau analyse the level of circularity of agricultural and food sectors in Europe and their contribution to the single Member State's circularity. Considering the central role played by the agri-food industry in achieving sustainable development goals, this study focuses on how this industry can save resources. The authors measured the circular economy performance in the 27 European Union countries by gathering data from the EE-MRIO database EXIOBASE v3.7 and estimating, through a set of indicators, the level of circularity of the whole economic system, the agricultural sector and the agri-food sector. The outcome of the analysis is severe for Europe: the level of circularity is low and significant differences emerge between countries. It is apparent from research findings that more recycling and reusing actions should be done in EU countries. Interestingly, agriculture plays a role of high relevance for the whole economic circularity. The added value of agricultural production explains the differences in performance between EU countries. The contribution of this study is noteworthy. It offers evidence of how the agricultural and food industry is pivotal for the circularity and sustainable development of the entire economy. The comparison between EU countries offers further insights for European and national policymakers.

The article "Does the Covid-19 affect food consumption patterns? A Transaction Cost Perspective" by Bianca Polenzani and Andrea Marchini analyses the drivers and barriers for consumers in buying groceries online. It deals with a topic of increasing relevance for both food consumers and producers after the sudden changes caused by the Covid-19 pandemic on

food retailing. Referring to the transaction cost theory and making use of information gathered by a survey questionnaire from a sample of 199 Italian online food purchasers, the authors have modelled the role played by transaction costs and their antecedents (i.e., uncertainty, asset specificity, consumer interest) in determining the willingness to buy online in a scenario characterised by Covid-19 pandemic effects. The PLS-SEM model allowed the authors to show some interesting relationships between willingness to buy online and its antecedents. Discomfort caused by the pandemic has increased the willingness to buy food online, which has been slightly reduced by transaction costs. The study is relevant today in that it explores, in a theoretically-based manner, online grocery purchases in Italy, and it provides new insights to food producers and policymakers. Interventions should reduce user uncertainty in online shopping and ensure easy accessibility and a comfortable experience. The changes in consumption and purchasing patterns, also stimulated by the Covid-19 pandemic, have highlighted the opportunity of the online channel for consumers and the logistic and network issues for producers. This article deepens the knowledge of this very promising type of retailing channel for the food market from the consumer's viewpoint.

In the article "Differences between Italian specialty milk in large-scale retailing distribution", Valentina Merlino, Stefano Massaglia, Simone Blanc, Filippo Brun and Danielle Borra analyse the speciality milk market in Italy. The market is characterised by producers investing in milk speciality portfolios based on environmental and health attributes and consumers interested in these types of milk. This trend represents a new opportunity for food retailers to increase supply width, attractiveness, and profitability. Intending to analyse the composition and relationships of speciality cow milk products, the authors have gathered a large dataset of information, including the assortment of 52 points of sale belonging to eight different large-scale retailers in the North-West of Italy. Using bivariate and multivariate statistics, they analytically describe assortment width and depth. Results highlight that brand and origin are the most significant drivers of speciality milk portfolios. Other segmentation characteristics include prices and product features (e.g., green packaging). The article is of interest to both producers and retailers in illustrating a promising market segment in which product positioning depends on a careful combination of multiple features such as brand reputation, health- and environment-related attributes, packaging and origin, together with retailer marketing and pricing policies. The article, therefore, contributes to increasing the knowledge about the negotiating power between producers and retailers and, at the same time, the opportunity for cooperation. The article also offers an understanding of the scenario in which consumers make

their milk product choices today, considering the increasing diversification of diets, benefits sought from the products, contexts of consumption and perceived qualities.

The current issue continues with three regular submissions that resulted in two article and a note.

In the article "Functional food consumption by Portuguese university community: knowledge, barriers and motivators", Paula Moutinho, Inês Andrade and Angela Macedo focus on a critical component of health at the centre of sustainable food systems: Functional Food (FF). The study investigates the most significant determinants of FF consumption: knowledge about the concept of FF, perception of barriers as well as food choice motivators, and socio-demographic characteristics. A web-based survey collected information from a sample of 467 respondents selected from all Portuguese universities. Using SPSS and FACTOR software to analyse the data of this sample of consumers from the academic community, the authors provide the FF consumer profile in the Portugal university context, showing their main attitudes, behaviours, and perceptions towards FF. Findings from the study indicate a low level of knowledge concerning FF, maybe due to the relatively recent introduction of FF in Portugal. Authors suggest educational and regulatory strategies in addition to short-term marketing and advertising strategies: a better level of communication (advertising and correct labelling) should help overcome the major obstacles in developing the FF market in Portugal.

In their paper "Sustainable transition and food democracy: The role of decision making process in Solidarity Purchasing Groups", Gustavo Magalhães De Oliveira, Gaetano Martino, Chiara Riganelli, and Michela Ascani address a relevant topic: the organisational mechanisms implemented by Solidarity Purchasing Groups (SPGs) to coordinate multiple and conflicting objectives. SPGs are a specific kind of Alternative Food Network whose goals are to provide food to group members, whilst contributing to the environment, health protection, social and ethical goals such as the pursuit of democracy and social justice. Through an internet survey with 121 valid questionnaires, the authors highlight the importance of decentralising decision rights to form democratic participation in SPGs. In particular, engagement, expectations and trust, reinforced by a routinised process, are important drivers that allow a group to promote and practice democracy effectively. This work opens a debate and new research trajectories about the linkages between the organisational forms of SPGs and the coordination of agri-food value chains.

Finally, in the Note "Fostering the debate among scholars to support the advancement of knowledge in the food-related consumer research: A commentary" Riccardo Vecchio raises the issue of author-reviewer dynamics in the peer-review process. He suggests that the attempt to please reviewers may affect the quality and impact of published research. In this opinion paper, starting from his own experience in publishing research articles, he wants to stimulate a debate among the academic community of food economists on whether and how the current peer-review practices and habits allow the authors to exploit the potential of their research efforts fully. He finally advocates the dissemination of guidelines for the peer-reviewing process of consumer-related manuscripts, providing practical instructions on how to act as a reviewer that can strongly support inexperienced reviewers and provide a term of reference for all.

We have some updates regarding the journal's indexing and abstracting. Economia Agro-alimentare is now listed in CABELLS JOURNALYTICS (www2.cabells.com/about-journalytics), a curated list of over 11,000 academic journals spanning 18 disciplines. Its purpose is to guide researchers and institutions in getting the most impact out of their research. They use several metrics to compare journals and provide information such as published articles, editors, acceptance rates, and invited article percentages. In addition, the journal has been indexed in the ICI Journals Master List database for 2021 after having passed the evaluation process positively. The Index Copernicus Value (ICV) calculated by the ICI experts for 2021 is 119.05. The journal is indexed in ICI since 2012; the previous evaluations are available at the Index Copernicus website: https://journals.indexcopernicus.com/search/details?id=32678&lang=en.

This news confirms the journal as a well-known and respected outlet for high-quality research. More than ever, we appreciate the support of our community of authors, reviewers, and readers, and we express our heartfelt gratitude to the SIEA Presidential Board for the unconditional support and for granting us full autonomy in the editorial management. We heartfully thank the publisher's staff and all those who contribute to maintaining and improving the quality and impact of the journal for the work done despite the difficulties created by the global pandemic.

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Trends in consumers' preferences towards fresh-cut vegetables during the Covid-19 pandemic

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Abstract

The fresh-cut sector has shown a positive trend in recent years, due to the "ease of use" and the increasing innovation in the quality and safety features of these products. However, in Italy, a negative trend was observed during the lockdown Covid-19. The objective of this study is to investigate consumer preferences for fresh-cut products and to identify the sensory and extrinsic attributes that influence consumer choice. It also examines whether consumer behaviour has changed during the lockdown Covid-19. An online questionnaire was administered to a convenience sample of 427 consumers. A one-way ANOVA was conducted to identify preferences for specific types of fresh-cut products; then, a factor analysis was conducted to highlight key socioeconomic variables and product attributes. Finally, a cluster analysis was conducted to identify homogeneous consumer groups.

The results indicate that some attributes, including "ease of use", "texture" and "colour" show a high level of interest and appreciation by consumers. The outcomes also reveal that there has been a change in consumer attitudes during the lockdown Covid-19, mainly for reasons related to the difficulty in food procurement, the fear of contagion during purchasing occasion, and higher prices. The findings of this research contribute to the knowledge of consumers' behaviour towards fresh-cut products in the period of lockdown Covid-19.

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Introduction

The human health benefits of consuming fresh fruits and vegetables are well known to consumers who are increasingly health conscious and committed to wellness in their lifestyles (Migliore *et al.*, 2017; Pappalardo *et al.*, 2017; Lorente-Mento *et al.*, 2022).

Scientific research has shown that a diet based on fruits and vegetables reduces the risk of cardiovascular, heart, metabolic, and degenerative diseases (Zhang *et al.*, 2005; Chen *et al.*, 2006; Dai *et al.*, 2006). Accordingly, policy makers have developed and strengthened food guidelines and directives to influence consumers' healthy dietary choices (Alzamora *et al.*, 2000; Pappalardo and Lusk, 2016). To illustrate, healthy diet guidelines recommend daily consumption of fresh fruits and vegetables, with a recommended daily intake of at least 400 g per capita, according to the World Health Organization (WHO, 2008).

In recent decades, there have been significant changes in the lifestyle and eating habits of consumers, who are increasingly looking for healthy foods (Chinnici *et al.*, 2019; Baselice *et al.*, 2017; Lorente-Mento *et al.*, 2022), but at the same time have less time to prepare meals (Girgenti *et al.*, 2016). In this context, to increase the daily per capita consumption of fruits and vegetables, the fresh-cut sector plays an important role in the convenience and freshness of the minimally processed product. Thanks to the improvement of post-harvest technologies, these products provide additional services (cleaning, peeling, washing, cutting), while preserving the freshness and genuineness of fresh product (Colelli, 2001; Galati *et al.*, 2019; Amodio *et al.*, 2011; Jang *et al.*, 2011; Lorente-Mento *et al.*, 2022). Since their development in the European market in the 1980s, consumers have increasingly purchased them. In Italy, the sales volume of fresh-cut products increased from 95.8 thousand tons in 2010 to about 126 thousand tons in 2018, representing a growth of over 30%, and the sales value increased from 731 million euros in 2010 to 816 million euros in 2018, representing an increase of about 12% (italiafruit.net, 2018).

As shown by the relative penetration index (share of fresh-cut vegetable buyers in fresh vegetable buyers), the consumption of fresh-cut fruits and vegetables in Italy increased from 70% in 2011 to 81.3% in 2020 (Ismea, 2021).

Consumption of fresh-cut fruits and vegetables, more specifically fresh-cut salads, is steadily increasing (Merlino *et al.*, 2020; Testa *et al.*, 2021), due to the increasing demand of consumers who recognize the benefits of combining convenient consumption with a product perceived as fresh, natural, and healthy (Baselice *et al.*, 2017). Health attitudes are an important motive for consumers' purchase decisions of fresh-cut products (Nassivera and Sillani,

2015). Moreover, in addition to healthy and timesaving motives, other factors such as sociodemographic and psychometric variables play an important role in shaping consumer demand for these products (Fusi *et al.*, 2016; Stranieri *et al.*, 2017; Baselice *et al.*, 2017; Ricci *et al.*, 2018; Contini *et al.*, 2018). To illustrate, the characteristics of fresh-cut products most appreciated by consumers generally refer to the convenience of saving time, quality, and nutritional value analogous to fresh products (Rico *et al.*, 2007; Jang and Moon 2011; Oner and Walker, 2011; Bigatti, 2019; Fruitbook Magazine, 2020), high added value, and reduction of household waste (Colelli and Elia, 2009).

However, despite their popularity, these products can be vectors for pathogens (Faour-Klingbeil *et al.*, 2016). In addition, fresh-cut products are negatively evaluated for their environmental impact due to the use of chemicals in the cultivation phase, high water consumption in the washing phase, the use of non-renewable energy resources, and non-biodegradable/recyclable resources for packaging materials (Fusi *et al.*, 2016; Raffo & Paoletti, 2022). These issues, combined with environmental impacts and food safety concerns, contributed to a negative trend for the fresh-cut sector during the Covid-19 pandemic (Ismea, 2021; Fruitbook Magazine, 2021).

The Covid-19 pandemic caused a global health crisis that also affected the economic system (De Maria *et al.*, 2020). The spread of the virus prompted several countries around the world to take extraordinary measures to contain it, which inevitably had consequences for economic markets (De Maria *et al.*, 2020). The Covid-19 pandemic significantly affected consumer purchasing behaviour and dietary habits (Grunert *et al.*, 2021; Pappalardo *et al.*, 2020). The lockdown Covid-19 had a strong impact on sales of ready-to-eat salads. The fresh-cut sector recorded a total value of 814 million euros in 2020, with –7% in value and –4.5% in volume compared to 2019 (Ismea, 2021). In Italy, during the first phase of lockdown in 2020, the sector of fresh-cut products showed a negative performance, despite the extraordinary efforts made by companies to ensure the supply of products to channels store (Ismea, 2021).

In 2020, the fresh-cut sector in Italy shows its first decline: –4.1% the decrease in volumes sold wholesale and even more significant the decrease in spending: –5.6% compared to 2019 with the lowest average prices (Ismea, 2021).

Underlying this trend are certainly new buying habits during the Covid-19 pandemic period (Montefrio, 2020).

Studies have shown that consumer habits and eating behaviours toward fruits and vegetables generally changed during the Covid-19 pandemic (Bracale and Vaccaro, 2020; Di Renzo *et al.*, 2020) with consequence on food markets (Lee *et al.*, 2021).

The literature on consumer purchasing behaviour towards fresh-cut products during the restriction period is scarce, and there is a gap in understanding the reasons for the change in purchasing behaviour toward these products. To the best of our knowledge, this is the first article to examine consumer behaviour during the Covid-19 restriction period with regard to fresh-cut products.

The purpose of this study is to understand consumer behaviour and preferences related to various attributes of different fresh-cut products, the change in purchasing behavior towards these products and the reasons that led to this shift in consumer purchasing behaviour during the lockdown Covid-19.

The objectives of this study are to: (1) analyse consumer preferences for different type of fresh-cut products; (2) evaluate attributes considered important to consumer purchase decisions and which sensory and extrinsic attributes that influence consumption decisions; (3) examine whether there are well-established homogeneous consumer groups; (4) test whether consumer behaviour toward fresh-cut products changes during Covid-19 lockout.

To examine the major impacts of the Covid-19 pandemic on the fresh-cut sector, a survey was conducted. An online questionnaire was sent to a convenience sample of Sicilian consumers (Italy). A one-way ANOVA was conducted to identify preferences for specific types of fresh-cut products and a factor analysis to summarise and highlight the main socioeconomic variables and product attributes influencing fresh-cut consumption. Finally, a cluster analysis was conducted to identify homogeneous consumer groups. The results of this research contribute to the knowledge of consumer behaviour toward fresh-cut products during the lockout Covid-19 period. The results of this work could be useful to industry and government.

1. Materials and methods

A questionnaire was sent online via Google Moduli to a sample of 427 Sicilian (Italy) respondents. The survey period extended from June to September 2020, and respondents were immediately informed of the privacy and anonymity of their answers. The online survey allows for easier data collection and processing. In addition, online questionnaires provide a dynamic pool of options for question design.

The questionnaire was submitted to a convenience sample. This sampling method implies that the results should be interpreted with caution due to the reduced possibility of inference to the general population. Several studies examining how consumer food-related behavior changed during the pandemic relied primarily on convenience samples (De Backer *et al.*, 2020; Murphy

et al., 2021). The first part of the questionnaire aimed to collect the main socioeconomic characteristics of the respondents, such as gender, age, family size, education level, employment, and average monthly income (Massaglia *et al.*, 2019; Lorente-Mento *et al.*, 2022). The second part focused on consumer preferences for different types of fresh-cut product considered (Lorente-Mento *et al.*, 2022). Specifically, respondents were asked questions aimed at determining the level of knowledge, familiarity, interest, and frequency of consumption of fresh-cut products. The questions aimed to code attitudes towards different types of fresh-cut products and were organized as binary questions (yes/no). The third part of the questionnaire examined consumption of different vegetable categories and preferences for sensory and extrinsic attributes. The variables selected were the main questions analyzed in the food purchase literature (Roininen *et al.*, 1999; van Trijp and van der Lans, 2007; Massaglia *et al.*, 2019; De Gennaro *et al.*, 2021). These questions aimed to code preference for different categories of fresh-cut products, as well as sensory and extrinsic attributes using a Likert scale (from 1 = "not relevant" to 7 = "very relevant"). In addition, this section of the questionnaire also explores whether consumption of fresh vegetables decreased during the Covid-19 lockdown, as well as the reason for this decrease in consumption. In addition, respondents were also asked a question about changes in the amount consumed after Phase 1 of the Covid-19 lockout. Table 1 provides an overview of the variables collected in the survey and used in the model.

Table 1 - Variables used in the model

Variables	**Type**	**Coding**	**Min**	**Max**
Gender	Dummy	(0 = Male; 1 = Female)	0	1
Age group	Categorical	1-3 (1 = 18-39; 2 = 40-59; 3 = Equal to or greater than 60)	1	3
Family members	Categorical	1-9	1	9
Education level	Categorical	1-3 (1 = Elementary school; 2 = High school; 3 = University degree and post degree)	1	3
Employment	Categorical	1-5 (1 = Employed; 2 = Unemployed; 3 = Homemaker; 4 = Retired; 5 = Student)	1	5
Monthly net income	Categorical	(1 = Below 2,000€; 2 = 2,001-4,000€; 3 = Over 4,000€)	1	3
Have you ever heard about ready for use vegetables?	Dummy	(0 = No, 1 = Yes)	0	1
Are you familiar with fresh-cut products?	Dummy	(0 = No, 1 = Yes)	0	1

Table 1 - continued

Variables	Type	Coding	Min	Max
Are you interested in consuming fresh-cut vegetables?	Dummy	(0 = No, 1 = Yes)	0	1
Do you regularly consume fresh-cut vegetables?	Dummy	(0 = No, 1 = Yes)	0	1
Lettuce consumed	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Carrots consumed	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Mushrooms consumed	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Spinach consumed	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Mixed salad consumed	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Nutritional properties	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Taste	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Practicality	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Timesaving	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Colour	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Consistency	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Freshness	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Flavour	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Juiciness	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Affordability	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
Safety	Categorical	1-7 (1 = Not relevant; 7 = Very relevant)	1	7
During Phase 1 of the Covid-19 emergency did you decrease your consumption of fresh-cut vegetables?	Dummy	(0 = No, 1 = Yes)	0	1
Reason for reduction of fresh cut salad during Phase 1* of lockdown Covid-19	Categorical	1-6 (1 = No answer; 2 = Difficulty in finding; 3 = Mistrust of the product due to fear of contagion; 4 = Distance to the place of purchase; 5 = No difficulty; 6 = High prices)	1	6
After Phase 1 of lockdown Covid-19, how did the amount consumed change?	Categorical	1-4 (1 =No answer; 2 = Has increased; 3 = Has decreased; 4 = Has remained unchanged)	1	4

* Phase 1 of lockdown Covid-19 in Italy (9 March - 3 May 2020).

First, a one-way analysis ANOVA was performed along with a post-hoc Tukey test to determine whether sensory and extrinsic attributes (Scarpa and Del Giudice, 2004; Caracciolo *et al.*, 2020) differed significantly

among the different types of fresh-cut products. A factor analysis was then performed to summarize preferences for sensory and extrinsic attributes. Factor orthogonalization was performed along with the Varimax method, which allows for a simpler and more correct interpretation of the results (Kaiser, 1960; Kaiser and Rice, 1974). The statistical model was tested using the KMO test and Bartlett's test based on the partial correlations between the variables to determine if the hypothesized model was a good fit to the data. In analyzing the factor matrix, we considered 0.50 as the absolute minimum value following Hair *et al.* (2009), who categorized the factor loadings as 0.30 = minimal, 0.40 = important, and 0.50 = significant.

Factorial analysis was also performed for sociodemographic variables and then a cluster analysis was performed based on the individual factor loadings to identify homogeneous groups of consumers. We use the k-means non-hierarchical classification procedure (k-means cluster analysis) to define the clusters by minimizing the Euclidean distances between centroids in an iterative process. To test the differences between clusters, the ANOVA test was performed to test the association between fresh-cut products and the reason for change in consumption during Covid-19 (García *et al.*, 2010; Franke *et al.* 2012).

The sociodemographic characteristics of the sample are summarized in Table 2. The sample consists of 57.8% female respondents. This percentage is slightly higher than in the Sicilian population, as shown by data from Istat (2021).

The majority of respondents are between 18 and 39 years old (74.0%), have at least a college degree and live in a family of four (45.0%). In terms of employment, the majority of respondents are employed (54.3%) and have an income of up to €2,000.00/month (53.1%).

Table 2 - Socio-demographic characteristics of the sample (n. = 427)

Variables	**Sample**		**Sicilian population***
	n.	**%**	**%**
Gender			
Male	180	*42.2*	*48.1*
Female	247	*57.8*	*51.9*
Age group			
18-39	316	*74.0*	*31.5*
40-59	93	*21.8*	*35.3*
Equal to or greater than 60	18	*4.2*	*33.2*

Table 2 - continued

Variables	Sample		Sicilian population*
	n.	%	%
Education level			
Elementary school	31	*7.3*	*56.6*
High school	186	*43.6*	*32.3*
University degree or post university degree	210	*49.2*	*11.1*
Family size			
Single	18	4.2	*33.3*
2 members	55	*12.9*	*27.1*
3 members	115	*26.9*	*19.3*
4 members	192	*45.0*	*15.1*
5 members	36	8.4	*4.0*
Over 5 members	11	*2.6*	*1.3*
Employment			
Employed	232	*54.3*	n.a.
Unemployed	40	*9.4*	n.a.
Housewife	20	*4.7*	n.a.
Retired	8	*1.9*	n.a.
Student	127	*29.7*	n.a.
Monthly net income			
Below 2,000€	227	*53.1*	n.a.
2,001-4,000€	128	*30.0*	n.a.
Over 4,000€	72	*16.9*	n.a.

* Source: Italian Institute of Statistics – ISTAT (2021).

2. Results

2.1. *Overall results*

Table 3 shows the results of ANOVA, which reveal different attribute values and significances for each of the products investigated.

In general, among the product categories investigated, lettuce salad obtained significantly higher values for all sensory and extrinsic attributes studied, followed by mushrooms and spinach, while mixed lettuce obtained the lowest values.

For the lettuce salad, it should be noted that of all the attributes considered, “taste” received the highest and statistically significant score, followed by the attributes “practicality”, “colour”, “juiciness” and “nutritional properties”.

Table 3 - Mean of sensory and extrinsic attributes for all products analysed

Attributes	**Fresh-cut salad**				
	Lettuce	**Carrots**	**Mushrooms**	**Spinach**	**Mixed**
Nutritional properties	2.838***	3.064**	3.018***	2.927***	3.076**
Taste	2.336***	2.596***	2.559***	2.609***	2.682
Practicality	2.058***	2.364	2.315***	2.344**	2.372
Timesaving	2.109***	2.368	2.311**	2.334*	2.342*
Colour	2.479***	2.770*	2.721***	2.744**	2.770*
Consistency	2.179***	2.446	2.346***	2.394***	2.461
Freshness	2.353***	2.592	2.514***	2.506***	2.575
Flavour	2.330***	2.551	2.477***	2.470***	2.580
Juiciness	2.876***	3.151*	3.315**	3.141**	3.184
Affordability	2.590***	2.606***	2.639**	2.634**	2.689
Safety	2.553***	2.724***	2.674***	2.672***	2.733***

Statistical differences were tested using ANOVA.
*, **, ***, indicate significance at 0.1; 0.05 and 0.01 level, respectively.

2.2. *Results of Factor analysis*

The first group of variables considered are the socioeconomic variables, which explain 63.7% of the total variance. The validation of the model was tested using the KMO test and Bartlett's test, which yielded a model adequacy test of 0.691 and 137.469 (p-value 0.000), respectively (Table 4).

The first extracted factor, explaining 24.2% of the variance, characterized respondents aged 40-59 years (+0.621), with monthly income above 4,000 euros (+0.711) and negatively correlated with employment (–0.697).

The second factor, explaining 20.7% of the total variance, characterizes consumers with a high level of education (+0.898) and a young age (–0.544).

The third factor describes respondents with a higher number of family members (+0.695) and female gender (+0.775).

*Table 4 - Rotated component matrix of socio-demographic characteristics**

Variables	Factor		
	1_SD	2_SD	3_SD
Gender			0.775
Age	0.621	–0.544	
Education level		0.898	
Family members			0.695
Employment	–0.697		
Monthly net income	0.711		
Total Variance	24.2	20.7	18.8
KMO test	0.691		
Bartlett's test of sphericity	137.469		
Sign	0.000		

* Factor loadings less than 0.50 have not been reported.

The rotated component matrix of the sensory and extrinsic attributes analysed is shown in Table 5. Factor analysis allowed the identification of two factors explaining 74.7% of the total variance and obtaining high scores on

*Table 5 - Rotated component matrix of attributes analysed**

Variables	Factor	
	1_AT	2_AT
Nutritional properties		0.901
Taste		0.895
Practicality	0.788	
Timesaving	0.764	
Colour	0.810	
Consistency	0.876	
Freshness	0.825	
Flavour	0.843	
Juiciness	0.842	
Affordability		0.615
Safety		0.820
Total Variance	45.9	28.8
KMO test	0.894	
Bartlett's test of sphericity	4289.586	
Sign	0.000	

* Factor loadings less than 0.50 have not been reported.

the KMO test (0.894) and on Bartlett's test 4289.586 (p-value 0.000) for the goodness of the model used. The first factor shows positive correlations between the attributes "colour", "consistency", "freshness", "flavour" and "juiciness") with the attributes "practicality" and "time saving". This first factor explained 45.9% of the total variance. The second factor, explaining 28.8% of the total variance, shows a positive correlation between the extrinsic attributes "food safety" and "affordability" with the attributes "nutritional properties" and "taste".

2.3. *Results of Cluster analysis*

To investigate whether there are well-established homogeneous consumer groups among the respondents, a cluster analysis was performed. The cluster analysis identified 3 homogeneous consumer groups. The main characteristics of these groups are shown in Table 6, which also shows the factor scores in the centroids with the K-mean.

Table 6 - Results of cluster analysis

Variables	**Clusters**			**p-value**
	1. Pragmatists (n. = 163)	**2. Skeptics (n. = 133)**	**3. Healthy Consumers (n. = 131)**	
Factor 1_SD	0.791	–0.302	–0.677	0.000
Factor 2_SD	0.404	–0.776	0.286	0.000
Factor 3_SD	0.071	–0.002	–0.087	0.402
Factor 1_AT	–0.034	–0.833	0.888	0.000
Factor 2_AT	0.576	–0.103	–0.612	0.000

Consumption of the different types of fresh product and the reasons for the change in consumption during and after lockdown Covid-19 are shown in Table 7.

Table 7 - Consumption of fresh product and reasons for change in consumption during and after Phase 1 lockdown Covid-19 among consumer groups

Variables	Clusters			p-value	Chi-Square
	1. Pragmatists (n. = 163)	2. Skeptics (n. = 133)	3. Healthy Consumers (n. = 131)		
Lettuce consumed - 1	0.17	0.41	0.24		
Lettuce consumed - 2	0.09	0.13	0.15		
Lettuce consumed - 3	0.28	0.23	0.09		
Lettuce consumed - 4	0.16	0.08	0.13	< 0.001	51.125
Lettuce consumed - 5	0.10	0.04	0.12		
Lettuce consumed - 6	0.06	0.05	0.13		
Lettuce consumed - 7	0.13	0.08	0.14		
Mushrooms consumed - 1	0.50	0.59	0.40		
Mushrooms consumed - 2	0.22	0.16	0.11		
Mushrooms consumed - 3	0.07	0.10	0.11		
Mushrooms consumed - 4	0.04	0.05	0.15	< 0.001	34.060
Mushrooms consumed - 5	0.06	0.05	0.08		
Mushrooms consumed - 6	0.04	0.02	0.10		
Mushrooms consumed - 7	0.07	0.03	0.05		
Spinach consumed - 1	0.20	0.44	0.41		
Spinach consumed - 2	0.24	0.28	0.18		
Spinach consumed - 3	0.27	0.19	0.11		
Spinach consumed - 4	0.11	0.02	0.12	< 0.001	48.427
Spinach consumed - 5	0.07	0.03	0.11		
Spinach consumed - 6	0.04	0.02	0.02		
Spinach consumed - 7	0.07	0.03	0.05		
Reason for reduction of fresh cut salad during Covid-19 Phase 1					
• No answer	0.21	0.30	0.49		
• Difficulty in supplying	0.66	0.24	0.10		
• Fear of contagion	0.71	0.22	0.07	< 0.001	68.497
• Distance to the place of purchase	0.53	0.32	0.15		
• No difficulty	0.36	0.36	0.28		
• High prices	0.50	0.33	0.17		
After Covid-19 Phase 1, how did the amount consumed change?					
• No answer	0.21	0.30	0.49	< 0.001	57.163
• Increased	0.57	0.17	0.27		
• Decreased	0.22	0.44	0.33		
• Unchanged	0.47	0.36	0.17		

1) Pragmatist. This is the largest group, with a sample size of 38.2%. This group is characterized by female respondents who have a high level of education and are employed. The family unit of these consumers consists of 4 people in 38% of the respondents, while the reported income level is medium-high. The reasons for purchasing fresh-cut products are the attributes of "nutritional properties" and "taste". Consumers in this cluster pay attention to the low price and safety. During Phase 1 of the lockdown, this group of consumers limited their consumption of fresh-cut salads because of fear of infection and greater difficulty in obtaining supplies of these products. After Phase 1 of lockdown Covid-19, respondents in this cluster declared to increase the consume of fresh-cut product.

2) Skeptics. This group makes up 31.1% of the sample and consists mainly of young women who are single and have an average low level of education. This group is not very concerned about the sensory characteristics of fresh-cut products and the convenience and time saving of fresh-cut products. In addition, this group indicated that the amount of fresh-cut products consumed decreased after Phase 1 of Covid-19 due to the higher prices that characterize this product category.

3) Healthy consumers. They represent 30.7% of the sample. This group includes consumers with a high level of education. These consumers attach great importance to the sensory characteristics (color, texture, juiciness, taste) of fresh-cut products and evaluate with positive interest the practicality and time-saving features of fresh-cut products. This group does not take advantage of the low price, but pays attention to the sensory characteristics of the product. Regarding the consumption habits after Phase 1 Covid-19, there are no significant changes, although with a slight decrease.

3. Discussion

This paper examines consumer behaviour and perceptions of product attributes of fresh-cut products during the Covid-19 pandemic. To achieve the objective (1) of the study, consumer preferences for various fresh-cut products were analysed. It was found that respondents mostly consume lettuce salad, followed by spinach salad. In addition, the study investigates which sensory and extrinsic attributes influence consumers' choice to achieve objective (2). In general, the results show that the sensory and extrinsic attributes of lettuce salad received the higher importance for consumers. This can probably be explained by the greater popularity of lettuce salad in the market, which is therefore more familiar and well known by consumers. Moreover, among the attributes considered, "taste" is the most important attribute for consumers, followed by "practicality", "colour", "juiciness", and

"nutritional qualities". These results are consistent with previous research, which found that consumers consider product appearance as the primary purchase criterion for consumer behaviour in fresh-cut products (Kays, 1999). Specifically, colour was found to be a key attribute in consumer preferences and also influenced taste perceptions (Clydesdale, 1993). In addition, previous studies have found that the crunchy texture is an important attribute because consumers associate it with freshness attributes (Fillion & Kilcast, 2002; Szczesniak, 1998). Our results are also consistent with Pollard *et al.* (2002) on factors influencing consumer choice of fruit and vegetable products, which indicated that sensory attributes, price, and timesaving are relevant factors influencing consumer choice of fresh-cut products.

To respond to the objective (3) of this study, the cluster analysis shows the identification of three homogeneous groups of consumers. The "pragmatist" group is mainly female, employed, and has numerous family members. These consumers look for an affordable price, probably due to a medium income, but at the same time they also pay attention to food safety, as they are responsible for the family's purchases. The second group, the "Sceptics", is mainly composed of young women who are single and are not as concerned with the price and timesaving of fresh-cut products. Finally, the "Healthy Consumers" are women with a high level of education and a large family unit. They attach great importance to the sensory characteristics and the practicality and time-saving features of fresh-cut products.

To answer the objective (4) of this study, our study confirms that Covid-19 has significantly influenced consumers' purchasing behaviour and eating habits. Our results are consistent with other studies that found that purchasing behaviour for fresh product changed during the Covid-19 lockdown (Pappalardo *et al.*, 2020). The results show that purchasing behaviour tended to change in favour of conventional fresh products during the Covid-19 lockdown. Respondents stated that the reasons for the shift of behaviour were the fear of contagion in the grocery shop, difficulty in procurement these products at grocery stores, and also the higher prices that characterise this product category.

Moreover, the change in consumer behaviour might be influenced not only by external constraints due to the lockdown, but also by perceptions of the pandemic situation (Kozlowski *et al.*, 2020; Moran *et al.*, 2020). As is also evident from our results and consistent with other previous studies (Goolsbee and Syverson, 2020), the reduction in frequency of shopping or restaurant occasions is driven mainly by fear of contagion. On the other hand, concerns about health also contribute to an overall change in consumer behaviour (Laguna *et al.*, 2020, Murphy *et al.*, 2021). However, it is important to note that some changes in food-related behaviour during the pandemic may represent a temporary change. In addition, different consumers may change

their behaviour in different ways due to external conditions, demographic variables, or psychological characteristics (Grunert *et al*., 2021). Existing literature shows that there are different types of consumers who respond in different ways to the pandemic and that the magnitude of change is related to the severity of pandemic-related actions and their impact on consumer well-being (De Backer *et al*., 2020). Our study extends these findings by identifying clusters of consumers characterised by changes in self-reported behaviours associated with fresh-cut products.

Conclusions

Nowadays, the fresh-cut sector is concerned with improving the quality and safety of products (Artés *et al*., 2009). In addition, the techniques and technologies used in the fresh product sector are constantly evolving, and knowledge of consumer preferences is not yet fully explored and discussed in the literature. Increasing consumer attention to the health aspects of foods, and fresh-cut products in particular, has prompted scientific research to highlight the lack of information that should be addressed to gain a better understanding of consumer preferences for food attributes. Currently, consumers are paying more attention to different aspects and especially to the healthiness of food than before the pandemic.

The Covid-19 pandemic has generated a global economic crisis and is impacting economies around the world (Bulgari *et al*., 2021), affecting all aspects of life, including consumer behaviour in relation to food (Eftimov, *et al*., 2020). The consumer market for fresh-cut vegetables, despite the slight decline in 2020 caused by the Covid-19 pandemic, represents a key sector contributing to the improvement of the health status of the population (Merlino *et al*., 2020; Testa *et al*., 2021).

The results indicate that some attributes, including "ease of use", "texture" and "colour" show a high level of interest and appreciation by consumers. The findings of the study show that, overall, consumer behaviour changed during the lockdown Covid-19 due to supply difficulties, fear of contagion during purchasing occasion, and higher prices. However, this might be a temporary behaviour related to the one-time moment of the lockdown.

Although this study has some limitations, such as the small size of the consumer sample and the fact that certain sensory attributes (acidity, bitterness, etc.) were not considered, the results have contributed to the knowledge of consumer acceptance during the lockdown period for fresh-cut products. Moreover, the empirical approach described in this study allowed, on the one hand, the corroboration of the most preferred attributes and, on the other hand, the classification of homogeneous groups of consumers.

Furthermore, despite the composition of the sample of Sicilian respondents, the results of the study can also be extended to a broader scale, since Sicily is a representative demographic area in the national context of Italy, but also a representative area in the fresh-cut sector in the south of Italy.

Future research could replicate the study and provide more information on the extent to which the changes in eating behaviour observed in this study are permanent or whether they are a short-term response by consumers to a new exceptional situation.

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The Circular Economy in the Agri-food system: A Performance Measurement of European Countries

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Abstract

Agriculture and the agri-food industry are central to fostering economic growth and the Sustainable Development Goals' targets. However, to meet the world's future development, it is necessary to make the agri-food system more resource-efficient. The transition towards the circular economy (CE) paradigm is commonly seen as a promising strategy to overcome the critical issues affecting the sector. However, different theoretical and practical problems still need to be solved. Specifically, the CE performance measurement of specific sectors or national systems is crucial as it helps to identify and correct any deviation from the vision set out for achieving the sustainable development objectives. This article aims to contribute to CE research, focusing on European agriculture and the agri-food sector. Drawing on the EE-MRIO database EXIOBASE v3.7, this paper estimates the level of circularity in the European Union countries and the role of agriculture and agri-food in determining circularity. Results showed that circularity in the EU is low and significant differences between countries exist. Agriculture contributes to 80.5% of the entire amount of recycled materials in Europe. Vice versa, the contribution provided by the agri-food sector is limited to 1%. Some policy implications derive from this study.

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Introduction

Following the industrial revolution, the world economy has grown through the "extraction-production-consumption-disposal" model, based on easily denied assumptions (European Environment Agency, 2016), such as the abundance of available resources and economic convenience of their procurement. However, it is a common opinion that this linear "take-make-waste" model is not sustainable in the long term, requiring an urgent evolution to remedy the massive, negative impacts of humanity on society and the environment (Brandão *et al.*, 2020; Edgeman, 2020).

The circular economy (CE) stands in stark contrast to the linear model as it concerns an economy capable of reconstituting and regenerating itself, using renewable energy, and minimising waste due to the design of products that can be subsequently repaired, recycled and finally reused. In this perspective, CE is an approach to sustainable development that is gaining ever more attention among academics, politicians, and people in business (Ghisellini *et al.*, 2016; Golebiewski *et al.*, 2019; Kirchherr *et al.*, 2017; Korhonen, Honkasalo *et al.*, 2018; Xue *et al.*, 2010; Yuan *et al.*, 2006). Although CE studies are still in their initial phase and there are numerous fields to be explored yet (Korhonen, Nuur *et al.*, 2018), several scholars agree that it is "an idea and an ideal" (Gregson *et al.*, 2015, p. 218) to redirect the path of economic development and enable cyclical thinking towards the creation of a zero-waste economy (Homrich *et al.*, 2018; Zwier *et al.*, 2015).

The CE has been defined as an "umbrella concept" (Homrich *et al.*, 2018) under which there are various definitions that address the issue from different perspectives (Borrello *et al.*, 2020; Korhonen, Nuur *et al.*, 2018), although numerous are the authors (e.g. Blomsma & Brennan, 2017; Haas *et al.*, 2015; Haupt *et al.*, 2017; Hobson, 2016; Moreau *et al.*, 2017; Naustdalslid, 2014; Niero *et al.*, 2017; Singh & Ordoñez, 2016) who have relied on the definition provided by the Ellen MacArthur Foundation: "a CE is regenerative by design and aims to gradually decouple growth from the consumption of finite resources".

The CE consists of a continuous positive development cycle that preserves and enhances the natural capital, optimises the yields of the resources, and minimises system risks by managing finite stocks and renewable flows. According to the European Commission (2008), the CE is based on four principles (4R) – Reducing, Reusing, Recycling and Renewing –, which implies the review of all stages of production - that must comply with the fundamental criteria of eco-design, modularity and versatility, use of renewable energies, eco-systemic approach and recovery of materials (Ellen MacArthur Foundation, 2021) – and the supply chain involved in the production cycle.

However, it must be underlined that CE is first an economic strategy. In this sense, CE suggests innovative ways to switch from the current predominantly linear consumption system towards a material savings and resources regeneration system to achieve economic sustainability. With a specific reference to agriculture and the agri-food industry, it is pivotal to ensure the transition of this sector toward the CE paradigm to foster and achieve global development (De Pascale *et al.*, 2021).

Those key sectors for human wellness will face significant scenario changes and are called to solve issues such as resource scarcity, food loss and waste generation. The FAO (2019) estimated that in 2019, along the world's supply chain, was generated approximately 1.3 billion tons annually of waste with a cost of more than 1000 billion dollars per year. However, the agriculture and agri-food problems do not exhaust themselves in the mismanagement of resources and processes, that is, food production dependence on fossil fuel, non-renewable mineral resources, the exhaustion of groundwater reserves and excessive soil loss (Muscio & Sisto, 2020). Just think about how consumers' unsustainable consumption patterns is a major accomplice of agriculture in terms of its pressure on the environment and influence on climate change (Esposito *et al.*, 2020; Taghikhah *et al.*, 2019).

In this scenario, CE is seen as a possible and promising strategy to overcome the critical issues that affect those sectors (Esposito *et al.*, 2020; Hamam *et al.*, 2021), making the entire agri-food system more resource-efficient, with positive food security implications (Jurgilevich *et al.*, 2016; Muscio & Sisto, 2020). In effect, numerous are the expected benefits, that is, use a minimal amount of external inputs, reduce negative discharges to the environment, close nutrient loops, increase farming efficiency, improve the nexus into the food supply chain and among productivity sectors, increase competitiveness, stimulate innovation, boost economic growth (European Parliament, 2015; Ward, 2017). However, these benefits can be overshadowed by some critical issues that affect not only the agriculture and the agri-food sectors, such as theoretical (i.e., too multiple definitions), political and practical, also in terms of design, logistic, scale (i.e. processes, industrial site, business dimension, regions and economics) (Corvellec *et al.*, 2021; Muscio & Sisto, 2020; Walmsley *et al.*, 2019), and measurement (Circle Economy, 2021).

Especially the latter requires particular attention since the relevance of the CE into the actual economic strategies. Borrowing the phrase attributed to Peter Drucker, "if it cannot be measured, it cannot be managed", the CE performance measurement of specific sectors or national economies is crucial. Firstly because it is the first step in moving toward a circular food production system, a process that requires proper tools for effective measurement to support robust decision-making (Velasco-Muñoz *et al.*,

2021). Secondly, because of it helps to identify and correct any deviation from the vision set out for achieving several SDGs of the 2030 Agenda for sustainable development. In effect, the CE is seen as an engine of sustainability that improves traditional sustainability approaches based on eco-efficiency to reach a greener economy by promoting more appropriate, eco-friendly resource use and innovative business models (Hamam *et al.*, 2021). According to Xue *et al.* (2010, p. 1298) the CE "is the outcome of over a decade's efforts to practice Sustainable Development by the international economies and is the detailed approach towards Sustainable Development". In this vein, the current European Commission's target to close material loops and change the European economy towards a circular economy reveals the key role played by CE in reaching SD goals (European Commission, 2015; Geissdoerfer *et al.*, 2017). Moreover, CE contributes directly to several SDGs, such as SDG6, SDG7, SDG 8, SDG12, SDG15 (Schroeder *et al.*, 2019).

At the same time, research on agriculture and agri-food sustainability transitions toward the CE paradigm is still poor, especially concerning the measurement of circularity into the system (Hamam *et al.*, 2021; Muscio & Sisto, 2020).

This article aims to contribute to CE research, addressing the recent calls for research in CE in the agri-food sector (Hamam *et al.*, 2021). Specifically, the study focuses on the European context, which is among the world's leading producers and net exporters of agri-food products (European Commission, 2021b). Moreover, already from 2014, the concept of CE has become a strategic key to the development of the EU (see EU/COM/2014/0398 final) and to make it cleaner and more competitive (European Commission, 2021a). By the new Circular Economy Action Plan adopted in 2020, the EU reaffirmed the importance of the change towards the circular economy, also for the agricultural and agro-food sectors, highlighting how the food value chain is accountable for significant resources and environmental pressure. However, the EU economy is still largely linear, and the agricultural sector is a major user of natural resources (European Environment Agency, 2017, 2020; Muscio & Sisto, 2020).

Despite previous research at the macro level and few previous studies focused on some agri-food chains, such as pasta (Principato *et al.*, 2019) and tomato (Boccia *et al.*, 2019), as far we know, there are no studies that currently measure the circularity of the agricultural and agro-industrial sector of individual European countries.

Therefore, this paper aims to fill this literature gap by answering the following research question: "What is the level of circularity of the agricultural and agri-food sector of the European countries?". In particular, drawing on Aguilar-Hernandez *et al.* (2019) research and Environmentally extended multiregional input-output (EE-MRIO) database EXIOBASE v3.7,

this paper intends to measure the circularity of European countries and the role of agriculture and agri-food in determining their circularity.

The paper is organised as follows: Section 2 presents the methodology employed. Section 3 presents the results. The final Section presents discussions and conclusions and outlines the implications for practitioners, academics, and policymakers and makes recommendations for future research.

1. Background

The performance measures are pivotal for guiding and reviewing CE policies (Ekins *et al.*, 2019), as the look forward indicators provide guidance, and backwards ones give feedback and review performance. Moreover, indicators importance arises from the fact that their choice is a critical determinant of the behaviour of a system (Meadows, 1998). Recently, some authors (i.e. De Pascale *et al.*, 2021; Saidani *et al.*, 2019) have provided an overview of the CE indices, classifying them into three levels, micro, meso and macro. Nevertheless, the attempts to globally assess the current circularity of the system are thin, perhaps due to the great challenge required and several data limitations (Ekins *et al.*, 2019). Grounded in Material Flow Accounting, Haas *et al.* (2015) estimate the global economy circularity as the "share of actually recycled materials in total processed materials". Mayer *et al.* (2019) based their study on previous contributions (Haas *et al.*, 2015; Nuss *et al.*, 2017) and used the material flow approach to investigate the degree of circularity of the EU.

An important contribution to this direction has been provided by the Circle Economy (Circle Economy, 2021) approach aimed to estimate the degree of circularity of the global economy. The first document – the Circularity Gap Report – was published in January 2018, and the assessment of circularity was based on the Material Flow Accounting. The reports published every year "provide high-level insights into the global metabolism and key levers for transitioning to circularity" (Circle Economy, 2021), and measure the circularity as 'cycled materials' as a share of the total resources entering the economy. The Circularity Gap Report (Circle Economy, 2021) revealed that at present, our world is only 8.6% circular, leaving a massive Circularity Gap. This report relies on the EE-MRIO database EXIOBASE v3.7.

The Environmentally Extended Input-Output Analysis is a particularly useful framework that fits with the economic outlook used in CE and allows considering diverse measures for improving circularity, that is residual waste management, loop-closing in supply chains, product life extension and resource efficiency (Aguilar-Hernandez *et al.*, 2018; Walmsley *et al.*,

2019). In particular, according to Harris *et al.* (2021), EXIOBASE is the dominant database in the CE literature and has been used to assess the generation and recovery of waste, depletion of stocks and the circularity gap. Moreover, although previous authors have raised some problems regarding the completeness of EXIOBASE (Tisserant *et al.*, 2017), the reliability of the entire database is not affected, and MRIO analysis was demonstrated to be capable of quantifying global and regional flows of material and estimating the quantity of it that is recycled (Aguilar-Hernandez *et al.*, 2019). Relying on the EE-MRIO database EXIOBASE v3.7, other authors used the same database to analyse the mitigation of environmental impact related to food consumption in Denmark (Osei-Owusu *et al.*, 2022) or to test the implementation of the strategies of the product lifetime extension and resource efficiency (Donati *et al.*, 2020). In the same vein, Aguilar-Hernandez *et al.* (2019) first have estimated and compared the material circularity gap of more nations (43 nations and 5 global regions in 2011) in a consistent framework. They quantify the Circularity Gap (CG), a measure of the waste materials that are theoretically available for circularity resulting from "the generated waste, plus old materials removed from stocks and durable products disposed of (i.e. stock depletion), minus recovered waste". In other terms, for the circularity gap calculation, they proposed the use of a metric that considers how much of the unrecovered waste can be turned into the economy as products or materials. Their approach differs from previous studies since they made an explicit mathematical distinction between the added materials to stocks and the ones dispersed in the environment as dissipative emissions or other combustion residues, allowing to determine the actual fraction of waste that is circular in a given period. From the GC, the authors drew up two other indicators, the Circularity index (CI) and the Circularity gap index (CGI).

Based on these considerations, the Aguilar-Hernandez *et al.* (2019) framework is suitable for our research purpose.

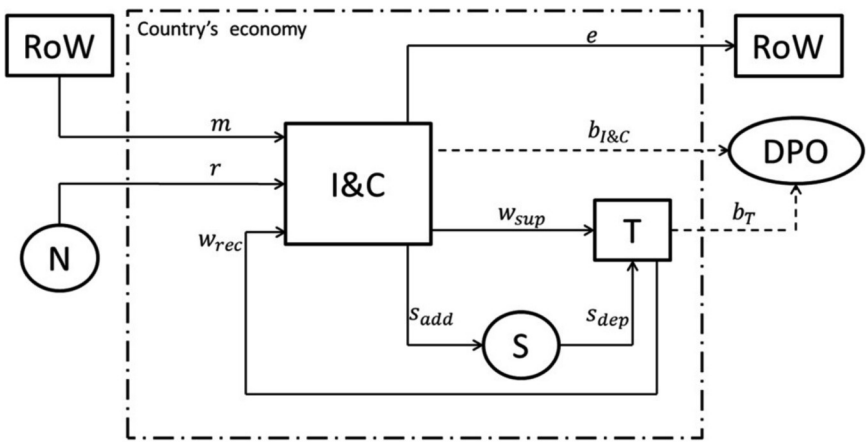
2. Materials and methods

Building upon the work of Aguilar-Hernandez *et al.* (2019), Figure 1 shows the system's boundaries of national material flow inputs, outputs and stocks according to the data contained in EXIOBASE.

In the material flow diagram, the solid boxes depict the socio-economic processes, and the solid circles represent the material stocks. The formers consider the intermediate activities and final demand (I&C), the waste treatment sectors (T), and the rest of the world economy (RoW).

The second are the stock of natural resources (N), the material in-use stocks (S), and the stock of nature from domestic processed outputs (DPO). The lines constitute the flows. The solid ones consider the imports (m), domestic resource extraction (r), recovered or secondary materials (w_{rec}), exports (e), waste generation or supply (w_{sup}), additions to stocks (s_{add}), and stock depletion (s_{dep}).

Figure 1 - System definition of national material flow inputs, outputs and stocks, own elaboration based



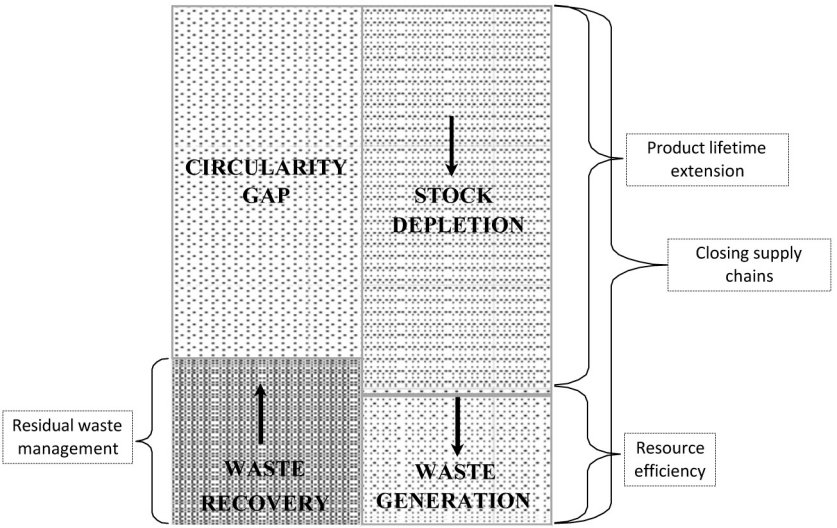
Source: Aguilar-Hernandez *et al.* (2019).

The dashed ones pose the flow of dissipative emissions and other combustion and biomass residues caused by intermediate activities and final demand ($b_{I\&C}$) and waste treatment (bT). According to the authors, as the analysis looks at a system boundary for the global economy, the imports (*m*) exports (*e*) are not considered, as well as the RoW sectors, that, due to physical trade balance to other regions, does not occur in this context. The Circularity Gap (CG) refers to all waste generated ruled out the recovery waste, which means the amount of waste not used in a circular way. In other terms, it is the difference between the entire volume of waste and the quota re-used or re-cycled.

It arises from three main outflows linked to the waste material: w_{sup}, s_{dep}, and w_{rec}. The CG can be expressed as follow:

$$CG = w_{sup} + s_{dep} - w_{rec} \quad (1)$$

Figure 2 - A circularity gap reduction through four intervention types



Source: Aguilar-Hernandez *et al.* (2019).

Figure 2 indicates the kinds of viable intervention (signalled by the white square with dots line border) to reduce the circularity gap by acting on stock depletion, material recovery, and waste generation, depicted in squares 1, 3 and 4. The up arrow indicates an increase in material flow, while the down arrow shows a decrease or delay in waste flow.

The Circularity Index (CI) for a specific country takes into account the import (*m*) – imports to EU and non-EU countries were considered for all 27 countries present in the study, as required by the CI formula, whereas the exports are not considered as not required by CI calculate – and domestic resource extraction (r), which together indicate the domestic material input of I&C.

In other words, this index shows the proportion of material that, after being introduced into the economy, is destined for reuse, and can be expressed as:

$$CI = \frac{w_{rec}}{r + m} \times 100 \quad (2)$$

In the same vein, the country Circularity Gap Index (CGI), which reports how much material, compared to that potentially reused, is not addressed to recycling, can be calculated as

$$CGI = \frac{CG}{w_{sup} + s_{dep}} \times 100 \quad (3)$$

and it indicates the weight of all waste generated ruled out the recovery waste with respect to the total weight produced. The level of circularity is, therefore, inversely proportional to the CGI (the circularity increases with the decrease of CGI).

Data to estimate the circularity in the entire economic system (European Union and its single countries) and the role of agriculture and agri-food in determining circularity were delivered from the input-output tables shown by the EXIOBASE database. It arises from three EU-funded projects, CREEA, EXIOPOL and DESIRE, and includes data on global production recipes and demand by households, firms and government for different products and services.

EXIOBASE database is a global environmentally extended monetary and hybrid multi- regional supply and use/input-output table (MR SUT/MR IOT) for 164/200 industries/products, 44 countries (28 EU countries, 16 non-UE countries and five rest of world regions), and 2000-2011 years (Merciai & Schmidt, 2018). It uses different units measure: physical mass (e.g., tonnes for tangible goods and waste), joule (for energy and electricity flows) and currency/economic value (for services).

This study uses version 3.3.17 of hybrid EXIOBASE's data sources, which includes national reports, the Food and Agriculture Organization (FAO, 2021), International Energy Agency (IEA), Eurostat, International Fertilizers Association (IFA) and Ecoinvent databases.

The algorithm of EXIOBASE multi-regional hybrid supply and use tables is divided into general and sectorial modules. The latter is "a self-standing block that delivers results to the general part" (Merciai & Schmidt, 2018, p. 519), such as the agriculture module, which aims to determine the mass balance for all the agricultural activities. Figure 3 represents the input-output table of the EXIOBASE agriculture module.

Concerning the crop activities, in the EXIOBASE, the input comprises the carbon dioxide, minerals, and nutrients from chemical fertilisers and manure, while the outputs (i.e., the productions of activities) include the harvested crops, emissions, manure excreted and the use of crop residues. Regarding the livestock activities, the inputs include oxygen for animal respiration, marketable and non-marketable feed, and grass, while the outputs involve the animal growth, emissions, and manure excreted.

The use of this version of EXIOBASE required some adjustments for calculating the index variables. Since there were no extension accounts of waste supply/use and stock depletions, these flows were calculated using the

Figure 3 - The EXIOBASE Agriculture module schema

CROPS	INPUT		LIVESTOCKS
	– Carbon dioxide	– Oxygen from animal respiration	
	– Minerals	– Market and non-market feed	
	– Nutrients from fertilisers and manure	– Grass	
	OUTPUT		
	– Harvested crops *	– Animal growth**	
	– Emissions	– Emissions	
	– Manure excreted***	– Manure excreted***	
	– Crop residues		

* Paddy rice, wheat, cereal grains nec, vegetables, fruit, nuts, oil seeds, sugar cane, sugar beet, plant-based fibers, crops nec.
** Cattle, Pigs, Poultry, Meat animals nec, Animal products nec, Raw milk, Wool, silk-worm cocoons, Fish and other fishing products, services incidental of fishing.
*** Conventional treatment, biogas treatment.
Source: Authors elaboration.

MR-SUT e MR-IOT. To identify the w_{sup}, both for the activities and the final demand, we considered 22 activities related to incineration, biogasification and land application, composting and land application, waste-water treatment, and landfill. The s_{dep} was estimated by the Gross fixed capital formation item presented in the final demand. The w_{rec} were identified considering 20 activities related to re-processing, recycling, biogasification and composting products. The *r* was represented by 18 activities related to wool and silk, forestry products, fishing activities and extraction of metals, fossil fuels, stone, sand, clay and other mining and quarrying products. The *m* are indicated by all material flows from other countries, except those related to waste recovery. The wsup and sdep were derived by MR-SUT. The wrec, r and m have been calculated from the MR-IOT (please see Appendix 1 for details on the list of items included in the variables of CI and CGI indexes).

Finally, two linear regression analyses across the 27 countries were applied to estimate if the general Circularity Index – that for its inherent nature represents the most relevant index in our study because provides a measure of

the level of circularity – would depend on the domestic level of economy and on the economic weight of agriculture:

$$CI_i = \alpha + ß_1 \, GDP_i \quad (4)$$

$$CI_i = \alpha + ß_1 \, AEV_i \quad (5)$$

where CI_i is the Circularity Index by each *i*-country, α is a constant, ß is the coefficient related to the independent variables, GDP*i* is the pro-capita Gross Domestic Product by each *i*-country, AEV_i is the pro-capita Additional Economic Value of agriculture by each *i*-country.

The choice of applying two regressions was suggested by the need of prevent possible interdependency between the two variables. In this term, we would highlight not only the magnitude and the statistical significance of each variable, but also the degree of relation between each variable and the level of circularity (dependent variable).

Data on national GDP and AEV were extracted from the Eurostat database and represent annual average values with reference to the period 2011-2020.

3. Results

A preliminary analysis was carried out to offer a snapshot of what is occurring in the entire economic system of Europe. The findings on circularity in the whole economic system of Europe are shown in Table 1.

Firstly, the analysis shows that Europe is very far from the global average of the circular economy. Although it pains to say it – while using different versions of the database and methodological approaches – the fact is that Europe is only 4.1% circular, almost half of the already shallow global value of 8.6% (Circle Economy, 2021). However, it must be underlined that the different ways of calculation and versions of the database can affect magnitudes. Therefore, obtained results are not fully comparable with those shown in the Circularity Gap Report. Basically, the level of circularity related to the entire EU system is found to be low.

The best country is Ireland, equal to approximately three times the European average. Although at levels not comparable to this score, Denmark and France also show a good rate of circularity, placing themselves in second and third place, respectively.

However, 11 out of 27 countries re-employ less than 3% of material introduced into the economic system, with Malta, Bulgaria, and Greece representing the three worst countries, respectively.

Concerning the amount of materials that are not addressed to recycling compared to that potentially reused, Europe shows an average of 72.3%. Specifically, 24 out of 27 countries reveal a CGI above 50%, of which 13 are

above 70%. Given the nature of these indexes, the country ranking by CGI reflects that by CI – in an inverted way – with only two countries (Denmark and Ireland) showing a score below 50%.

Finally, looking at the amount of waste not used circularly, European countries show an average of 27.5 million tonnes with sharp differences among them. The worst country is Bulgaria, followed by France and Germany, whereas the best one is Slovenia, followed by Croatia and Lithuania.

Table 1 - Analysis of the circularity degree of the entire European economic system

EU Country	**CI (%)**	**CGI (%)**	**CG (M tonnes)**
Austria	3.6	74.0	14.8
Belgium	4.4	61.0	12.4
Bulgaria	1.7	98.8	143.0
Croatia	3.3	65.4	2.0
Cyprus	2.2	98.5	23.8
Czech Republic	2.5	54.6	5.3
Denmark	8.3	42.1	5.0
Estonia	2.5	92.3	10.4
Finland	2.4	91.4	33.0
France	6.6	76.0	123.9
Germany	3.6	58.0	57.9
Greece	2.1	93.3	57.3
Hungary	6.0	85.0	23.9
Ireland	13.0	33.6	4.8
Italy	3.3	68.4	42.5
Latvia	5.0	83.5	4.9
Lithuania	5.6	62.3	2.9
Luxembourg	2.6	98.5	26.1
Malta	1.5	99.7	15.0
Netherlands	5.5	51.0	14.9
Poland	3.7	58.0	28.4
Portugal	2.6	64.8	7.2
Romania	5.0	54.7	10.3
Slovak Republic	2.2	78.0	5.7
Slovenia	5.1	55.5	1.5
Spain	5.0	62.9	37.0
Sweden	2.1	89.5	28.6
EU-27	4.1	72.3	27.5

To answer our research question, firstly, we analysed the circularity degree in the EU agricultural (Table 2) and the agri-food sectors (Table 3). Secondly, we measured the weight of latter compared to the circularity recorded in each country and estimated the weight of agriculture on agri-food (Table 4).

Table 2 - Analysis of the European agricultural sector circularity degree

EU Country	**CI (%)**	**CGI (%)**	**CG (M tonnes)**
Austria	2.7	49.8	3.9
Belgium	3.4	36.4	3.5
Bulgaria	1.5	50.9	1.6
Croatia	2.9	48.3	0.9
Cyprus	2.1	51.0	0.4
Czech Republic	2.0	38.3	2.2
Denmark	7.0	15.2	1.0
Estonia	1.6	48.6	0.5
Finland	1.4	66.9	3.6
France	5.7	32.2	15.9
Germany	2.5	43.9	23.0
Greece	1.2	59.5	3.6
Hungary	4.6	34.3	1.7
Ireland	12.7	9.3	0.9
Italy	2.4	56.0	18.2
Latvia	4.2	37.5	0.5
Lithuania	5.3	29.2	0.7
Luxembourg	2.0	40.1	0.2
Malta	1.5	89.6	0.4
Netherlands	4.4	32.5	5.5
Poland	2.9	32.2	7.6
Portugal	2.2	44.4	2.6
Romania	4.1	41.1	4.9
Slovak Republic	1.7	54.7	1.5
Slovenia	4.1	36.4	0.5
Spain	3.8	33.7	8.5
Sweden	1.8	56.4	3.6
EU-27	3.4	43.3	4.4

Table 3 - Analysis of the European agri-food sector circularity degree

EU Country	CI (%)	CGI (%)	CG (M tonnes)
Austria	2.7	49.0	3.8
Belgium	3.5	34.8	3.3
Bulgaria	1.5	50.9	1.6
Croatia	3.0	47.6	0.9
Cyprus	2.1	50.9	0.4
Czech Republic	2.1	37.8	2.2
Denmark	7.0	14.9	1.0
Estonia	1.6	48.2	0.5
Finland	1.4	66.3	3.6
France	5.7	31.4	15.5
Germany	2.6	42.6	22.3
Greece	1.2	59.4	3.6
Hungary	4.7	32.9	1.6
Ireland	12.7	9.1	0.9
Italy	2.5	54.6	17.8
Latvia	4.2	37.2	0.5
Lithuania	5.4	28.7	0.7
Luxembourg	2.0	39.9	0.2
Malta	1.5	89.6	0.4
Netherlands	4.6	29.8	5.0
Poland	3.0	30.1	7.1
Portugal	2.2	44.2	2.6
Romania	4.1	41.0	4.9
Slovak Republic	1.7	54.3	1.5
Slovenia	4.1	36.2	0.5
Spain	3.9	31.8	8.0
Sweden	1.8	55.5	3.5
EU-27	3.4	42.6	4.2

Looking at the European agricultural sector, the results highlight the role of this sector in determining European circularity. In fact, on average European countries recycle 3.4% of the materials introduced into the economic system, equal to 80.5% of the entire amount of recycled materials in the EU. Also specifically in this sector, the most striking countries in this

area are Ireland, Denmark, and France, whereas Greece, Finland and Malta represent the less virtuous.

Regarding materials that are potentially recyclable but have not been sent for recycling, the average value of the agricultural sector is equal to 43.3% (CGI). However, slightly more than half of these countries are below this average. The average CG of the agricultural sector is equal to 4.4 million tonnes. The surprising fact is that as many as 9 countries have a value of less than one million and 13 less than 2 million.

The amount of waste not used in a circular way by the 5 worst countries (Poland, Germany, Italy, France, Spain) is compressively bigger more than two times that of the other 22 countries.

The circularity analysis on the agri-food sector traces the agricultural sector data partially. Even in this case, the recycling percentage of materials introduced into the sector is 3.4%, and the most virtuous countries are Ireland, Denmark, and France.

Compared to that potentially reused, the average of material not addressed to recycling is slightly lower than that of the agriculture sector (CGI equal to 42.6%). Only Ireland reports a score of less than 10%.

Concerning the amount of waste not used in a circular way in the agri-food sector, European countries show an average of 4.2 million tonnes. One of the most noteworthy data is that the three worst countries (Germany, Italy and France) record together almost the same value (55.6 million tonnes) deriving from the sum of the other 24 countries (58.4 million tonnes).

The impact of the agricultural and agri-food sector on the CE in individual countries is showing the Table 4. It should be noted that the calculated scores mean how much a single economic sector contributes to the entire country's circularity and not the circularity solely inherent to that given sector. This occurs because the nature of the input-output matrix does not allow us to enucleate a single production sector as a closed system, as each sector is characterised by exchanges of materials with the rest of the economy. This means it is impossible to arrive at circularity measures referable to a single sector. Still, we can calculate the level of circularity in the entire economic system that derives from the processes of a given sector.

The findings showed that:

1. The agriculture contributes, on average, to determine 80.5% of the total circularity in the European countries. This percentage varies from 57.4% of Finland to 97.7% of Malta. It means that agriculture plays a predominant role in determining circularity in all EU countries.
2. Looking at the agri-food sector leaving out its upstream phases, it results that it affects circularity by about 1% (the difference between the agri-food and agriculture CIs). Indeed, the agriculture weights for about 99% on the agri-food index, highlighting how the weight of the other phases along the supply chain is little more than insignificant in promoting circularity processes.

Table 4 - Impact of agricultural and agri-food sector on the circularity of each country

EU Country	CI agricultural sector/ CI country (%)	CI agri-food sector/ CI country (%)	CI agricultural sector/ CI agri-food sector (%)
Austria	74.5	75.7	98.4
Belgium	76.9	78.8	97.5
Bulgaria	89.1	89.2	99.9
Croatia	88.3	89.5	98.7
Cyprus	97.5	97.7	99.8
Czech Republic	81.1	81.7	99.2
Denmark	84.0	84.3	99.6
Estonia	64.9	65.4	99.2
Finland	57.3	58.4	98.2
France	85.6	86.5	98.9
Germany	70.1	71.6	97.9
Greece	59.2	59.4	99.6
Hungary	77.0	78.7	97.9
Ireland	97.4	97.6	99.9
Italy	73.1	75.5	96.9
Latvia	84.7	85.0	99.6
Lithuania	95.3	95.9	99.4
Luxembourg	76.4	76.6	99.7
Malta	97.7	97.8	100.0
Netherlands	79.7	82.9	96.2
Poland	78.2	80.7	96.9
Portugal	84.9	85.2	99.6
Romania	82.2	82.3	99.9
Slovak Republic	79.4	80.1	99.2
Slovenia	80.6	80.8	99.7
Spain	76.7	78.8	97.3
Sweden	82.3	84.1	97.8
EU-27	80.5	81.5	98.8

However, we investigated to understand if and how much a possible improvement of the Gross Domestic Product and/or agricultural production value would affect national CI. Therefore, the general CI was separately regressed on two variables: the pro-capita Gross Domestic product, the pro-capita Additional Economic Value of Agriculture (AEV) according to the formulas (4) and (5).

The regression model was tested to estimate if the preferable model is with or without the constant term. As a testing procedure, we adopted the Generalised likelihood-ratio test, which allows us to evaluate a restricted model with respect to the adopted model. Findings suggest that the preferred model is without the α term.

Results of both regression analyses are reported in Tables 5 and 6.

Table 5 - Estimation of the linear regression model – Independent variable: GDP

Variables		**Coefficient**	**S.E.**	**z**	**p-value**	
Constant	α	–	–	–	–	
GDP	β_1	0.001	0.001	3.904	0.001	***
$R^2 = 0.641$						
		Test on regression				
LL value	*LL' value**	χ^2	*d.f.*	χ^2 *(0.95)*		
–60.8	–61.6	1.6	1	3.84	0.000	***

* Alternative model without the constant term.

Table 6 - Estimation of the linear regression model – Independent variable: AEV

Variables		**Coefficient**	**S.E.**	**z**	**p-value**	
Constant	α	–	–	–	–	
AEV	β_1	0.005	0.001	10.9	0.000	***
$R^2 = 0.908$						
		Test on regression				
LL value	*LL' value**	χ^2	*d.f.*	χ^2 *(0.95)*		
–48.3	–48.7	0.9	1	3.84	0.000	***

* Alternative model without the constant term.

Results suggest that Circularity Index is positively and significantly related to the per capita Gross Domestic Product even if the magnitude is shallow. The correlation between the two variables is not much high ($R^2 = 0.641$),

but this analysis can depend on the differences in economic structure across regions (Aguilar-Hernandez *et al*., 2019). The Circularity Index also results positively and significantly related to the per capita Additional Economic Value of agriculture. The magnitude of the coefficient is about five times higher than that estimated for the GDP, and the standard coefficient of determination is high ($R^2 = 0.908$). These findings imply that the elasticity of CI with respect to the only agricultural sector income is remarkably higher than the entire domestic income of each country.

4. Discussion and conclusions

The role played by agriculture and the food sector in the natural resources sustainable use and preservation is undisputed. The European Commission (2020) intends to make European food the global standard for sustainability (Corrado & Zumpano, 2021) and sees the food sector as one of the most strategic in guiding the transition to a circular economy (Chiaraluce, 2021; Rocchi *et al*., 2021). To that end, it promotes the more efficient use of resources, that, in turn, contributes to economic growth, new market opportunities development and the mitigation of climate change.

Bearing in mind that CE principles can be deployed as a "toolbox" to attain several SDGs (Schroeder *et al*., 2019) and Green Deal, the centrality of the agri-food sector, in Europe as in worldwide, emerges strongly, even in light of emergencies linked to the Covid-19 pandemic.

Given the above, and since the use of indicators is essential for monitoring the progress of sectors and countries towards a circular model (Poponi *et al*., 2022), the purpose of this study was to estimate the circularity level of the agricultural and agri-food sector in European Union countries.

First, we examined the overall level of circularity of the 27 European countries, finding that the average of the countries differs from the values previously observed by Aguilar-Hernandez *et al*. (2019) and stands at a much lower level (–4.5 points of difference) than the world average of 8.6 % as it stands in the last Circularity Gap Report (Circle Economy, 2021). This is despite a series of ambitious CE policies adopted by the European Commission, e.g., its "Circular Economy Package" (launched in 2015 and subsequently updated in 2018).

By focusing on the agri-food sector, although circular agriculture is still a new concept (Mor *et al*., 2021), the data clearly showed how relevant it is in pursuing the transition to an CE in the EU because the agriculture sector recycles 80% of the entire amount of recycled materials in Europe. However, there are major differences between countries. A significant finding is the scarce contribution of agri-food to the CE of countries. This data reflects the

amount of food waste generated in Europe, estimated at 88 million tonnes, equal to about 20% of the total food produced (Eurostat, 2018; Stenmarck *et al*., 2016). It is an absurd situation that odds with economic and ethical principles since it means to lose 143 billion euros, and 33 million Europeans cannot afford a quality meal every second day (Eurostat, 2018). Furthermore, the waste of food also depletes the environment of limited natural resources, clashed with SDG 12 aimed at ensuring the population's well-being by reducing the excessive consumption of natural resources, and SDG 2 that fosters the sustainability of food production systems and achievement of food security.

Further noteworthy results concern the relationships between CI and, by a hand, the additional value of the agricultural production and, by another hand, the GDP of each EU country: the first positive and significant, the second negative and significant. Therefore, increasing the domestic value of the agricultural production increases the circularity provided by the agriculture sector and the whole countries.

Therefore, it emerges that agriculture – given the state of technology nowadays and the nature of the inherent technical and economic processes – is the sector that contributes most to determining the level of CI in European countries – as confirmed by the incidence of the CI by agriculture on the global CI – and a possible increase of the additional value of agricultural production can affect CI more than can happen with a proportional improvement of the entire GDP. In other terms, an increase in the level of circularity of the EU economy passes primarily by the development of agriculture rather than by a general improvement of the performance of the entire economic system due to the relative high elasticity of this sector.

Basically, the marked ability of agriculture to be a leverage for fostering circularity would derive from the physiological propensity of the sector to resort to technical practices based on the regeneration of natural resources and the re-use of waste materials even within the same farms that generate waste. On the other hand, it should be emphasised that more than in other sectors, there is a widespread tendency on the part of farmers to use the resources at their disposal with caution – i.e., efficiently – and this predisposes, among other things, to naturally seek forms of management of crops or livestock that are partly based on the re-use of waste.

In the light of these considerations, some policy implications can derive in terms of quality and quantity improvement of agriculture.

Although not acting on resource circularity enhancing and agricultural quality side (thus keeping the technological frontier unchanged), policies aimed at increasing agricultural production will increase the agricultural circularity and country circularity. This would occur even without necessarily rethinking the agricultural model to be promoted in the direction of greater

circularity given the natural propensity of agriculture to resort per se to practices already centred on the re-cycle of the used resources. Obviously, the eventual introduction of virtuous processes that increasingly apply the CE principles and better integration, in this sense, with the upstream and downstream sectors of agriculture can increase the sector's ability to affect the overall circularity of the economic system.

Furthermore, new practices and innovation based on the CE approach have proved economically feasible as they create additional income and paid employment by the local population, lead to social benefits such as better living conditions and new openings, and ecological benefits, such as better waste management, less natural contamination and fewer fossil fuel by-products (Mor *et al.*, 2021).

To summarise, since the elasticity of the agricultural sector is greater than that of all the entire economy, qualitative and quantitative interventions on the agricultural sector will generate a more than proportional return to the benefit of the circularity of all the EU countries.

The food sector, in contrast, requires policy expressly oriented to the quality side. Indeed, the scarce contribution that the sector today, without the primary phase, provides to the economic system in terms of circularity is very limited. This suggests that it would be not enough to improve the sector's performance if, at the same time, the processes and the farms' organisation are not rethought towards practices with a high rate of circularity. It implies that a remarkable effort needs to be made to promote innovations in different fields such as prevention of packaging waste, eco-design and end-of-life packaging management, food waste prevention and food surpluses management. This is one of the better ways to increase food quality and security, environmental sustainability, and the economic well-being of countries (Fiore *et al.*, 2019).

On the other hand, this paper presents some limits that can open up prospects for further studies.

First, findings are grounded in material flow accounting, but, as the CE is an economic strategy, future research can replicate our analysis on Monetary EXIOBASE.

Second, results are focused on the entire agriculture and food sector; future research can investigate differences among industries.

Third, according to Ellen MacArthur Foundation (2021) "A circular economy is one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times". Because the Aguilar-Hernandez *et al.* (2019) framework employed in this study considerers the mass of recycled waste but not "how much energy is required to restore the recovered material back to the desired material or product" (Cullen, 2017, p. 483), future research can investigate the

material losses and energy inputs associated with recycling that can affect the environmental benefits deriving from the agribusiness transition toward a circularity paradigm.

Fourth, previous research highlighted the pivotal role of biomass in the circularity economy analysis (Allain *et al*., 2022; Erb & Gingrich, 2022; Paes *et al*., 2019). In the European Union (EU), the importance of biomass feedstocks has been boosted by policies that promote renewable energy and biobased products, and being a source of material goods and energy, biomass is of critical importance in a circular economy (Sherwood, 2020). Since changes in time of vegetation biomass per unit area (biomass density) is an essential climate variable that directly measures the sequestration or release of carbon between terrestrial ecosystems and the atmosphere (FAO, 2009), to realize the transformative potential of the circular economy unsustainable biomass production must be eliminated (Haas *et al*., 2020). Future research can investigate how such a variable affects the circularity of the agribusiness industry in the European countries. Finally, analyses on different versions of the EXIOBASE database can lead to results hardly comparable among scholars. The hope is that an increasingly accurate database will be available in the future, also to allow a more sophisticated computational procedure of circularity indicators.

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Appendix 1
List of items included in the variables of CI and CGI indexes

Waste Supply (considered both for Activities and Final demand sheets)
- Food waste for treatment: biogasification and land application
- Food waste for treatment: composting and land application
- Food waste for treatment: incineration
- Food waste for treatment: landfill
- Food waste for treatment: waste water treatment
- Inert/metal/hazardous waste for treatment: landfill
- Intert/metal waste for treatment: incineration
- Manure (biogas treatment)
- Manure (conventional treatment)
- Oil/hazardous waste for treatment: incineration
- Other waste for treatment: waste water treatment
- Paper and wood waste for treatment: composting and land application
- Paper for treatment: landfill
- Paper waste for treatment: biogasification and land application
- Paper waste for treatment: incineration
- Plastic waste for treatment: incineration
- Plastic waste for treatment: landfill
- Sewage sludge for treatment: biogasification and land application
- Textiles waste for treatment: incineration
- Textiles waste for treatment: landfill
- Wood waste for treatment: incineration
- Wood waste for treatment: landfill

Stock Depletion (derived from the voice "Gross fixed capital formation" from the Final Demand sheet)
- Air transport services (62)
- Aluminium and aluminium products
- Aluminium ores and concentrates
- Animal products nec
- Ash for treatment, Re-processing of ash into clinker
- Basic iron and steel and of ferro-alloys and first products thereof
- Beverages
- Biogas an other gases nec.
- Bottles for treatment, Recycling of bottles by direct reuse
- Bricks, tiles and construction products, in baked clay
- Cattle
- Cement, lime and plaster
- Ceramic goods
- Cereal grains nec
- Chemical and fertilizer minerals, salt and other mining and quarrying products nec
- Chemicals nec; additives and biofuels

- Coal, lignite and peat
- Coke oven products
- Collected and purified water, distribution services of water (41)
- Computer and related services (72)
- Construction work (45)
- Copper ores and concentrates
- Copper products
- Crops nec
- Crude petroleum and services related to crude oil extraction, excluding surveying
- Dairy products
- Distribution and trade services of electricity
- Distribution services of gaseous fuels through mains
- Education services (80)
- Electrical machinery and apparatus nec (31)
- Electricity by biomass and waste
- Electricity by coal
- Electricity by gas
- Electricity by Geothermal
- Electricity by hydro
- Electricity by nuclear
- Electricity by petroleum and other oil derivatives
- Electricity by solar photovoltaic
- Electricity by solar thermal
- Electricity by tide, wave, ocean
- Electricity by wind
- Electricity nec
- Extra-territorial organizations and bodies
- Fabricated metal products, except machinery and equipment (28)
- Financial intermediation services, except insurance and pension funding services (65)
- Fish and other fishing products; services incidental of fishing (05)
- Fish products
- Food products nec
- Food waste for treatment: biogasification and land application
- Food waste for treatment: composting and land application
- Food waste for treatment: incineration
- Food waste for treatment: landfill
- Food waste for treatment: waste water treatment
- Foundry work services
- Furniture; other manufactured goods nec (36)
- Glass and glass products
- Health and social work services (85)
- Hotel and restaurant services (55)
- Inert/metal/hazardous waste for treatment: landfill
- Inland water transportation services

- Insurance and pension funding services, except compulsory social security services (66)
- Intert/metal waste for treatment: incineration
- Iron ores
- Lead, zinc and tin and products thereof
- Lead, zinc and tin ores and concentrates
- Leather and leather products (19)
- Machinery and equipment nec (29)
- Manure (biogas treatment)
- Manure (conventional treatment)
- Meat animals nec
- Meat products nec
- Medical, precision and optical instruments, watches and clocks (33)
- Membership organisation services nec (91)
- Motor vehicles, trailers and semi-trailers (34)
- N-fertiliser
- Natural gas and services related to natural gas extraction, excluding surveying; inclulding liquid gas
- Nickel ores and concentrates
- Nuclear fuel
- Office machinery and computers (30)
- Oil seeds
- Oil/hazardous waste for treatment: incineration
- Other business services (74)
- Other Hydrocarbons
- Other land transportation services
- Other non-ferrous metal ores and concentrates
- Other non-ferrous metal products
- Other non-metallic mineral products
- Other services (93)
- Other transport equipment (35)
- Other waste for treatment: waste water treatment
- P- and other fertiliser
- Paddy rice
- Paper and paper products
- Paper and wood waste for treatment: composting and land application
- Paper for treatment: landfill
- Paper waste for treatment: biogasification and land application
- Paper waste for treatment: incineration
- Pigs
- Plant-based fibers
- Plastic waste for treatment: incineration
- Plastic waste for treatment: landfill
- Plastics, basic
- Post and telecommunication services (64)
- Poultry

- Precious metal ores and concentrates
- Precious metals
- Printed matter and recorded media (22)
- Private households with employed persons (95)
- Processed rice
- Products of forestry, logging and related services (02)
- Products of meat cattle
- Products of meat pigs
- Products of meat poultry
- products of Vegetable oils and fats
- Public administration and defence services; compulsory social security services (75)
- Pulp
- Radio, television and communication equipment and apparatus (32)
- Railway transportation services
- Raw milk
- Real estate services (70)
- Recreational, cultural and sporting services (92)
- Refined Petroleum
- Renting services of machinery and equipment without operator and of personal and household goods (71)
- Research and development services (73)
- Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods (52)
- Retail trade services of motor fuel
- Rubber and plastic products (25)
- Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motor cycles parts and accessoiries
- Sand and clay
- Sea and coastal water transportation services
- Secondary aluminium for treatment, Re-processing of secondary aluminium into new aluminium
- Secondary construction material for treatment, Re-processing of secondary construction material into aggregates
- Secondary copper for treatment, Re-processing of secondary copper into new copper
- Secondary glass for treatment, Re-processing of secondary glass into new glass
- Secondary lead for treatment, Re-processing of secondary lead into new lead
- Secondary other non-ferrous metals for treatment, Re-processing of secondary other non-ferrous metals into new other non-ferrous metals
- Secondary paper for treatment, Re-processing of secondary paper into new pulp
- Secondary plastic for treatment, Re-processing of secondary plastic into new plastic
- Secondary preciuos metals for treatment, Re-processing of secondary preciuos metals into new preciuos metals
- Secondary raw materials

- Secondary steel for treatment, Re-processing of secondary steel into new steel
- Services auxiliary to financial intermediation (67)
- Sewage sludge for treatment: biogasification and land application
- Steam and hot water supply services
- Stone
- Sugar
- Sugar cane, sugar beet
- Supporting and auxiliary transport services; travel agency services (63)
- Textiles (17)
- Textiles waste for treatment: incineration
- Textiles waste for treatment: landfill
- Tobacco products (16)
- Transmission services of electricity
- Transportation services via pipelines
- Uranium and thorium ores (12)
- Vegetables, fruit, nuts
- Wearing apparel; furs (18)
- Wheat
- Wholesale trade and commission trade services, except of motor vehicles and motorcycles (51)
- Wood and products of wood and cork (except furniture); articles of straw and plaiting materials (20)
- Wood material for treatment, Re-processing of secondary wood material into new wood material
- Wood waste for treatment: incineration
- Wood waste for treatment: landfill
- Wool, silk-worm cocoons

Waste recovery

- Ash for treatment, Re-processing of ash into clinker
- Bottles for treatment, Recycling of bottles by direct reuse
- Food waste for treatment: biogasification and land application
- Food waste for treatment: composting and land application
- Manure (biogas treatment)
- Manure (conventional treatment)
- Paper and wood waste for treatment: composting and land application
- Paper waste for treatment: biogasification and land application
- Secondary aluminium for treatment, Re-processing of secondary aluminium into new aluminium
- Secondary construction material for treatment, Re-processing of secondary construction material into aggregates
- Secondary copper for treatment, Re-processing of secondary copper into new copper
- Secondary glass for treatment, Re-processing of secondary glass into new glass
- Secondary lead for treatment, Re-processing of secondary lead into new lead

- Secondary other non-ferrous metals for treatment, Re-processing of secondary other non-ferrous metals into new other non-ferrous metals
- Secondary paper for treatment, Re-processing of secondary paper into new pulp
- Secondary plastic for treatment, Re-processing of secondary plastic into new plastic
- Secondary preciuos metals for treatment, Re-processing of secondary preciuos metals into new preciuos metals
- Secondary steel for treatment, Re-processing of secondary steel into new steel
- Sewage sludge for treatment: biogasification and land application
- Wood material for treatment, Re-processing of secondary wood material into new wood material

Resource extraction
- Aluminium ores and concentrates
- Biogas an other gases nec.
- Chemical and fertilizer minerals, salt and other mining and quarrying products nec
- Coal, lignite and peat
- Copper ores and concentrates
- Crude petroleum and services related to crude oil extraction, excluding surveying
- Fish and other fishing products; services incidental of fishing (05)
- Iron ores
- Lead, zinc and tin ores and concentrates
- Natural gas and services related to natural gas extraction, excluding surveying; inclulding liquid gas
- Nickel ores and concentrates
- Other Hydrocarbons
- Other non-ferrous metal ores and concentrates
- Paddy rice
- Precious metal ores and concentrates
- Products of forestry, logging and related services (02)
- Sand and clay
- Stone
- Uranium and thorium ores (12)
- Wool, silk-worm cocoons

Imports
- Aluminium and aluminium products
- Aluminium ores and concentrates
- Animal products nec
- Basic iron and steel and of ferro-alloys and first products thereof
- Beverages
- Biogas an other gases nec
- Bricks, tiles and construction products, in baked clay
- Cattle
- Cement, lime and plaster

- Ceramic goods
- Cereal grains nec
- Chemical and fertilizer minerals, salt and other mining and quarrying products nec
- Chemicals nec; additives and biofuels
- Coal, lignite and peat
- Coke oven products
- Copper ores and concentrates
- Copper products
- Crops nec
- Crude petroleum and services related to crude oil extraction, excluding surveying
- Dairy products
- Electrical machinery and apparatus nec (31)
- Fabricated metal products, except machinery and equipment (28)
- Fish and other fishing products; services incidental of fishing (05)
- Fish products
- Food products nec
- Foundry work services
- Furniture; other manufactured goods nec (36)
- Glass and glass products
- Iron ores
- Lead, zinc and tin and products thereof
- Lead, zinc and tin ores and concentrates
- Leather and leather products (19)
- Machinery and equipment nec (29)
- Meat animals nec
- Meat products nec
- Medical, precision and optical instruments, watches and clocks (33)
- N-fertiliser
- Natural gas and services related to natural gas extraction, excluding surveying; inclulding liquid gas
- Nickel ores and concentrates
- Office machinery and computers (30)
- Oil seeds
- Other Hydrocarbons
- Other non-ferrous metal ores and concentrates
- Other non-ferrous metal products
- Other non-metallic mineral products
- P- and other fertiliser
- Paddy rice
- Paper and paper products
- Pigs
- Plant-based fibers
- Plastics, basic
- Poultry
- Precious metal ores and concentrates

- Precious metals
- Printed matter and recorded media (22)
- Processed rice
- Products of forestry, logging and related services (02)
- Products of meat cattle
- Products of meat pigs
- Products of meat poultry
- products of Vegetable oils and fats
- Pulp
- Radio, television and communication equipment and apparatus (32)
- Raw milk
- Refined Petroleum
- Rubber and plastic products (25)
- Sand and clay
- Stone
- Sugar
- Sugar cane, sugar beet
- Textiles (17)
- Tobacco products (16)
- Uranium and thorium ores (12)
- Vegetables, fruit, nuts
- Wearing apparel; furs (18)
- Wheat
- Wood and products of wood and cork (except furniture); articles of straw and plaiting materials (20)
- Wool, silk-worm cocoons

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Does the Covid-19 affect food consumption patterns? A Transaction Cost Perspective

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Abstract

The purpose of this research is to study transaction costs and their antecedents, in relation to the willingness to buy groceries online in Italy, and to observe the effect of Covid-19 is having in those. The study used a positivist deductive approach to the theory development. To evaluate the relations, we developed a PLS-SEM using SmartPLS version 3.3.3, and tested the model using WarpPLS 7.0. The pandemic's discomforts impact significantly the willingness to buy food online, and it is also a mediator between transaction costs and willingness to buy online. The findings may help those manufacturers struggling with low-performing e-commerce during the Covid-19 pandemic. When restrictions are enforced, manufacturers should take action to reduce the uncertainty associated with online shopping. From the political point of view, it highlights the need for institutional help in organising online supply chains.

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Introduction

Without any doubt, the Covid-19 pandemic has changed our lives. It affected the entire food system, creating uncertainty and discomforts in terms of both security and safety (Gao *et al.*, 2020; Goddard, 2020; Kinsey *et al.*, 2020; Galanakis, 2020). During 2020, the food sector overall saw a drastic cut in consumption. This figure is determined by the collapse of the Ho.Re.Ca. which goes from 86 billion euros in 2019 to 34 billion in 2020. On the other hand, part of this loss is balanced by the growth in retail sales, which allows to predict an increase in domestic consumption of about 6% compared to 2019 (Ismea, 2020). In 2020, there was an increase in e-commerce purchases (Osservatori.net, 2020), on both Italian and foreign sites. The food and grocery sector had a value of 2,5 billion euros, with a growth of 55% (Osservatori.net, 2020). The most relevant component (87% of the sector) is represented by food, with a growth of 85% compared to 2019. Nowadays, technology is increasingly invading everyday life, and web connection is more crucial than ever (Eurostat, 2020). Even before the Covid-19 Pandemic, the Internet was increasingly been used for interpersonal relationships, leisure, information and shopping. Despite the growing popularity of e-commerce channels (ISTAT, 2019), the agri-food sector lags in business to consumer (BTC) online sales volume. While food and grocery internet purchase are still marginal in Italy, it is increasing, also influenced by the Covid-19 Pandemics. They are followed by food delivery (ready-to-eat food) with 706 million (+19%) and niche products with 589 million euros (+63%). In particular, online confirms an important growth driver for large-scale distribution, with growth of 23.5% over 2020 in value and a turnover of 1.8 billion euros, equal to 2.5% of the total turnover of the sector (Consorzio Netcomm, 2021).

For what may concern online wine purchase, in Italy there are few big online retailers (XtraWine, Bernabei, and Soundtaste) which sell alcoholic beverages online (Socialmeter, 2020), but wine producers are far behind for e-commerce implementation. In 2020, e-commerce in Italy saw an overall increase of 8% compared to 2019, and only the food and grocery sector grew by 70% compared to the previous year (Nomisma Wine Monitor, 2021). Even if the numbers of web sales in the wine sector are lower than those of large-scale distribution (10% lower), the e-commerce of wine has achieved a turnover of between 150 and 200 million euros (Nomisma Wine Monitor, 2021). To be clear, in 2020 there was a real acceleration for e-commerce where over 8 million have chosen to buy wine online, about 27% of total wine consumers, compared to 17% in 2018 (Nomisma Wine Monitor, 2021). At the same time, there has also been an increase in the size of e-commerce: it is estimated that the weight on total sales in the retail channel should go

from 1% in 2019 to 2-3% in 2020 (Nomisma Wine Monitor, 2021). It could be interesting to notice that online shopping habits are different. In fact, consumers usually buy online products of a higher price range than those chosen during the in-person shopping on the shelf. For example, there is a relevant gap between the label price of still and sparkling wines, where the digital consumer spends 59% more, or € 3 per liter in physical spending and € 4.8 per liter in online shopping (Nomisma Wine Monitor, 2021).

In a nutshell, Covid-19 pandemic has brought to light the need for e-commerce sales to reach their full potential and for consumers to trust agri-food products purchased via web and applications.

Thus, the current paper tries to understand how the difficulties in acquiring grocery personally, due to the pandemic, have affected consumers' behaviour towards online shopping for groceries (food and wine). Transaction costs theory was already used to explain consumers' behaviour towards online shopping (Liang and Huang, 1998; Teo *et al*., 2004; Suki and Suki, 2017), but it lacks of contributions regarding online Grocery shopping, while there is some literature about food delivery (Chin and Goh, 2017). As for the relationship between Covid-19 and Willingness to Buy (WTB), there are interesting contributions (Gao *et al*., 2020; Hobbs, 2020; Kim *et al*., 2021), but they do not consider transaction costs (TC) and their antecedents. The study tries to bring together these two streams of research, maybe helping shed a light on how the Pandemic has affected consumers' behaviour towards online food purchase.

One of the distinguishing features of the current study is the use of PLS-SEM to evaluate Transaction Costs in relation to the willingness to buy groceries online. This methodology was already used to study online shopping behaviour regarding clothes and fashion purchases (Rahman and Mannan, 2018; Rodríguez *et al*., 2020), but also for food (Chin and Goh, 2017). In the current study, we used PLS-SEM, with bootstrapping as cross-validation method, carried out with SmartPLS 3.3.3 (Ringle *et al*., 2015), and checked using WarpPLS 7.0 (Brewster, 2011; Kock, 2017). While the first is a linear program, the second is non-linear, enabling us to check for the robustness of our results (Kumar and Purani, 2018). This particular way of proceeding makes our study one of the first to investigate consumers' transaction costs for grocery purchase, and the mediating role of Covid-19, using both linear and non-linear PLS algorithms. The findings may help develop managerial strategies, and study the effect of an exogenous variable on consumers' behaviour towards online food shopping. The results could also be crucial in elaborating policies and interventions aimed to encourage online purchasing, which is especially essential in helping to prevent the spread of the disease.

1. Background

Consumers and Transaction Costs

Transaction cost theory (TCT) aims to explain why actors choose a particular organisational form to transact, rather than another (Coase, 1937; Williamson, 1979, 1991). Three main dimensions characterise the TCT: asset specificity (As), Uncertainty (U) and Frequency (F) (Williamson, 1979, 1991). The first two are positively related to transaction costs. That is, by increasing them, the cost associated with the transaction increases. Asset specificity refers to the degree to which the investment in support of the transaction is re-deployable (Williamson, 1991). If an investment is not specific, it poses few hazards because it has alternative uses. Uncertainty is related to the cost associated with an unexpected outcome due to information asymmetry (Williamson, 1991). It could be related to both people and the environment. Frequency refers to the periodicity with which transactions occur (Williamson, 1991). Recurring transactions are associated with fewer uncertainties and risks due to the trust created between the actors, and therefore the frequency is negatively correlated with the transaction costs. In the current study, only two out of three antecedents of transaction costs were considered (asset specificity and uncertainty). This both because the frequency was already found out as not significant (Yeo *et al.*, 2017), and because it is was not included neither by Teo *et al.* (2004), nor by John and Weitz (John and Weitz, 1988). According to the previous studies, information technologies (IT) can change the governance structures associated with TC. In this regard, there are two main directions: one that states that IT has reduced transaction costs by favouring market mechanisms (Alt, 2017). The other, argues that use of IT fosters closer relationships with external partners (Alt, 2017). There are confirmations on both aspects, namely that the use of IT can favour market mechanisms as well as hierarchical relationships (Glassberg, 2007; Alt and Zimmermann, 2015). In particular, within Business-to-Customer and Customer-to-Customer transactions price and costs are signals, elements of the transaction. In the Business-to-Business transactions they are also used to manage the relationships between the actors (Glassberg, 2007). Thus, when the transaction is customer-oriented, Information technologies and buying online may reduce information asymmetry and uncertainty, due to the easy access to a great amount information (such as that about products, retailers or comparison), and thus reduce the associated transaction costs (Glassberg, 2007; Alt and Zimmermann, 2015). On the other hand, when the transaction is business oriented, there are elements involved in the transaction which may slow down e-commerce diffusion such as specific requirements, trust, managerial skills

and reputation (Glassberg, 2007). These elements may lead to establish closer strategic relationships when IT are involved.

The decision to buy online is nothing more than an organisational form of a transaction. According to the TCT, the alignment between organisational form and transaction should minimise the associated transaction costs (Gibbons and Roberts, 2013). The more the transaction is perceived as risky (high TC), the more centralised (hierarchical) the organisational form chosen is because it allows the actors to monitor the transaction closely. If the perceived transaction costs are low, they may choose a decentralised organisational form (market) because the incentives are sufficiently high to cover the associated hazards (Williamson, 1991). Although TCT is usually applied in Business-to-Business (BTB) transactions, several authors tried to use it to explain consumers' behaviour. Liang and Huang studied the acceptance of electronic products by consumers using transaction costs (Liang and Huang, 1998). Marchini *et al.* (2021) tried to classify different forms of food distribution, from the most centralised (home-made) to the most decentralised (large scale distribution), using transaction cost theory. According to their study, if the perceived transaction costs are low, consumers may choose a decentralised organisational form (Williamson, 1991; Marchini *et al.*, 2021).

Traditionally, consumer's behaviour towards online purchases is linked to dimensions such as satisfaction and loyalty (Rahman and Mannan, 2018; Rodríguez *et al.*, 2020). However, some authors have tried to study it using transaction cost theory (Teo *et al.*, 2004; Suki and Suki, 2017). In particular, Teo *et al.* (2004) sought to assess US and Chinese consumers' readiness to shop online using transaction cost antecedents, confirming the relationship between antecedents and perceived transaction costs for online purchase. As for online grocery shopping, Yeo *et al.* (2017) used an integrative theoretical approach based on Contingency Framework and Extended Model of IT Continuance to evaluate the structural relationship between different characteristics of food purchase (such as post-use utility, hedonistic motivations, price saving orientation), shopping characteristics online (convenience motivation, time-saving orientation, previous online shopping experience), consumer attitude and behavioural intention towards online food delivery. On the other hand, Suhartanto *et al.* studied the effect of quality on online service loyalty for delivery food. Finally, Chin and Goh (2017) used a PLS-SEM to assess consumers' intentions towards online food and grocery shopping.Their study found that perceived utility is a significant determinant of the decision to buy food online. Our study aims to link two research lines: TCT to study consumer behaviour, and online shopping for groceries (food and wine). The current study tries to observe the relationship between antecedents (in particular, As and U) and perceived TC associated

with online grocery purchase. Moreover, we try to evaluate whether TC affect consumers' behaviour (WTB), and how the Covid-19 has affected this relation. Considering the effects of Covid-19 on the food system, both in terms of security and safety (Gao *et al.*, 2020; Goddard, 2020; Kinsey *et al.*, 2020; Galanakis, 2020), we sought to observe both its direct effect on the willingness to buy online, and whether it has a mediating role between TC and WTB. Given the statistical data, it is expected that the perceived discomforts caused by Covid-19 would have a positive effect on the WTB food and wine online. According to the theory developed by Marchini *et al.*, (2021) we consider online shopping as a very decentralised organisational form, and consumer interests associated with online shopping, as a form of incentive (high incentives characterise decentralised transactions) (Williamson, 1979, 1991).

The study of Teo *et al.* (2004) found that TC had a negative and significant impact on WTB online. However, online shopping for food and wine has some peculiarities. First of all, consumers who shop for groceries online often look for innovative products and variety (Rohm and Swaminathan, 2004). Second, the mitigation of uncertainty, especially for infrequent purchases, is essential. Sellers can only use signals to mitigate consumers' uncertainty about their product, as they cannot inspect it in person. In this case, the information given on the website (Luo, 2002; Suki and Suki, 2017) and food-specific indications, such as labels and certifications (Riganelli and Marchini, 2016; Oncini *et al.*, 2020; Polenzani *et al.*, 2020), become crucial. Unlike Teo *et al.* (2004), we did not consider "Trust" among the antecedents of TC because it is already embedded in the other two dimensions (uncertainty and asset specificity) (Williamson, 1979, 1991).

2. Materials and methods

Conceptual Model

Uncertainty

In this context, consumers can be uncertain about both the product and the producer. Uncertainty about the product is defined as the difficulty of consumers in evaluating the product and predicting how it will behave in the future (uncertainty about performance) (Dimoka *et al.*, 2012). Producer uncertainty refers to the difficulty in assessing sellers' actual characteristics and predicting whether they will act opportunistically or not (Pavlou *et al.*, 2007). Furthermore, for online shopping, there is also uncertainty regarding web stores (Eastlick and Feinberg, 1999). In this context, conflicts arise

between the seller and the buyer regarding their different interests and purposes. On the one hand, if the buyer wants the best quality at the lowest price, the seller, on the other hand, wants to get the highest selling price in exchange for a lower quality. The seller can act opportunistically, taking advantage of his position and knowledge of the product (Akerlof, 1978).

Regarding the behavioural uncertainty towards online stores, problems could arise regarding consumers' ability to evaluate the contractual performance concretely (Teo *et al*., 2004). Nowadays, numerous tools have been developed to reduce it (Pavlou *et al*., 2007). In addition to certifications, which are very important for food products, there are also: reputation, informativeness of the website, product diagnostics, and social presence.

Corporate reputation is the consideration that people have of a company, based on the operations carried out by it. According to the literature, there is a positive relationship between perceived reputation and trust in online retailers (McKnight *et al*., 2002). A classic way to build a reputation online is the feedback system. Feedback means the possibility of leaving a comment or rating a particular service (or product) by entering a personal evaluation (Broutsou *et al*., 2012). Many providers (such as eBay, Amazon and Yahoo) have established such online reputation systems to promote the exchange of information on the credibility of individual merchants (Broutsou *et al*., 2012). Another tool is the information provided on the corporate website, which is defined as the degree to which a site offers information that buyers perceive as useful (Luo, 2002). Product diagnostics is the extent to which a buyer believes that a website helps evaluate a product (Kempf and Smith, 1998). It reflects the website's ability to provide relevant product information to help online shoppers accurately assess product quality. Offering proper online product diagnostics reduces product uncertainty as this is also a weapon against adverse selection. Finally, the concept of social presence refers to the extent to which a means of communication is perceived as truly capable of transmitting the participants' presence in the communication and making interactivity via the web closer to the consumer (Short *et al*., 1976). In a nutshell, it creates a perceptual illusion in which the user perceives distant entities, such as websites or online sellers, as if they were close (Choi *et al*., 2001). However, food and drink are particular products, the purchase of which is still closely related to physical components such as sight, smell and touch. Therefore, we hypothesised a positive impact of uncertainty on perceived transaction costs, and therefore a negative impact on the willingness to shop online.

H1. *Uncertainty may increase the transaction costs for grocery online purchase.*

Asset Specificity

As mentioned above, TCT defines Asset Specificity as the degree of specificity of durable investments made to execute particular transactions (Williamson, 1979). Asset specificity can be human and physical (Teo *et al.*, 2004). The first is the investment, in terms of time and effort, to acquire the necessary skills to purchase online (Teo *et al.*, 2004). The second is the economic investment made to pursue the transaction (Teo *et al.*, 2004). In this context, it can refer to all those specific actions and purchases made to buy online. Given the current wide availability of tools to buy via the web (smartphones, computers, tablets) and that they are essential for almost all daily activities, we have not considered this latter type of investment in the model.

The main problem with buying goods online is the learning process that the customer goes through (Liang and Huang, 1998; Teo *et al.*, 2004). It is common knowledge that inexperienced consumers are significantly influenced by the specificity of the assets, vice versa, the experienced ones, not at all (Teo *et al.*, 2004). As Liang and Huang (1998) reported, the buying process is complex as it consists of several steps. First, the search for information and comparison. Nowadays, this step also includes the negotiation phase, which takes place mainly through the comparison of related products and services on specific platforms. Then, examination, order and payment, delivery and post-service follow-up. Therefore, online acquisition is a complex process. It starts by learning where to buy the needed product, how and where to compare different products and websites, and how to save money by shopping online. These human investments, in time and effort, increase transaction costs. It follows that:

H2. *Asset Specificity may increase the transaction costs for grocery online purchase.*

Consumers' Interest

Satisfying consumers' interests may affect acceptance of online tools (Wigand, 1997). Following the actors have a bounded rationality. It means that they have limited memory and limited cognitive power. Thus, they are not capable of process or rather known all the information, and to reach an optimal decision may be difficult (Williamson, 1981). Therefore, opportunistic behaviours may arise, i.e., the actors may not be entirely honest about their decisions or try to take advantage of the situation (Teo and Yu, 2005). In this sense, the transaction governance may also depend on the actors' interests. Teo *et al.* (2004) consider convenience and economic utility as the main proxies for consumers' interest. In fact, it is fair to assume

that consumers, given the uncertainty of the situation and their bounded rationality, make decisions to maximise these two elements. The first can be defined as the perceived advantages of online shopping (Eastlick and Feinberg, 1999). Indeed, by shopping online, consumers can save time, effort, stay safe at home, and find the best product for their needs by checking different websites (Jiang *et al.*, 2011). Consumer interest (CI) has been found to have a significant impact on behavioural intentions related to online shopping for delivery food (Yeo *et al.*, 2017).

Economic utility refers to the alleged possibility of making better bargains (and prices) by shopping online (Eastlick and Feinberg, 1999; Teo *et al.*, 2004). It has an impact on behavioural intentions (Yeo *et al.*, 2017). Moreover, online sellers often apply specific discount strategies, making digital buying even more convenient. Additionally, consumers can compare websites and prices to find the best deal. Therefore, in the present study, we considered consumer interest as an antecedent of transaction costs for purchasing food and wine online, as a proxy of the opportunistic behaviours of the consumers, given their bounded rationality.

H3. *Consumer interests may decrease the transaction costs for grocery online purchase.*

In the literature about consumers' and transaction costs, the antecedents usually do not present interactions between themselves (Liang and Huang, 1998; Eastlick and Feinberg, 1999; Teo *et al.*, 2004; Teo and Yu, 2005). In fact, they may be considered as distinct features linked to transaction costs, each of them trying to capture a different shade of consumers behaviour in the transactional process.

Transaction costs, Willingness to Buy, and Covid-19

As earlier mentioned, online shopping can be seen as the most decentralised form of food acquisition. According to the literature, and the transaction costs theory, transaction costs (TC) can affect consumers' behaviour regarding online shopping (Liang and Huang, 1998; Eastlick and Feinberg, 1999; Teo *et al.*, 2004; Williamson, 1991). Thus, the following hypothesis:

H4. *There is a negative relationship between transaction costs and willingness to grocery onlin.*

According to the statistics, the Covid-19 has increased online food purchase (Gao *et al.*, 2020). The Pandemic has created several difficulties,

linked with the environmental perception. If the environment is perceived as risky, the consumers may change their behaviour accordingly (Kim *et al.*, 2021). The discomforts associated with Covid-19 pandemic (Covid) may have increased the willingness to buy online (Gao *et al.*, 2020; Hobbs, 2020; Kim *et al.*, 2021). Therefore, our fifth hypothesis is the following:

H5. *The discomforts associated with Covid-19 pandemic increase the willingness to buy grocery online.*

Given that, we would observe if the difficulties associated with Covid-19 may mediate the relationship between TC and WTB. In fact, if the transaction costs associated with online grocery purchase are high, the discomforts created by the pandemic may be perceived as higher, and this may influence consumers' behaviour regarding online purchase (WTB) (Gao *et al.*, 2020).

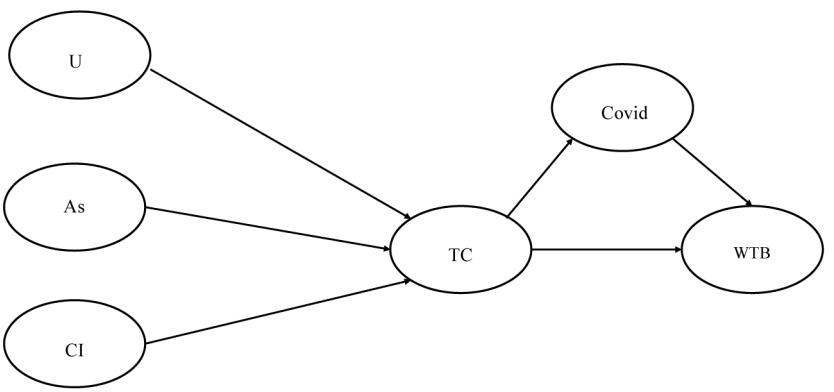
Therefore, the following hypotheses:

H6. *High transaction costs may increase the perceived discomforts associated with Covid-19.*

H7. *The perceived discomforts due to the Covid-19 pandemic mediate the relationship between transaction costs and willingness to buy grocery online.*

Figure 1 shows the Conceptual Model used for the analysis, with all the relations presented in the previous paragraphs.

Figure 1 - Conceptual Model



Source: Authors' elaboration.

Data Collection

To conduct the research, we used a positivist deductive approach to the theory development (Yeo *et al.*, 2017). Using a positivist approach should help avoid bias in the research (Saunders *et al.*, 2009). To limit costs, use digital-only means and facilitate collection, we used a non-probabilistic sampling method to collect the data (Armstrong *et al.*, 2014; Yeo *et al.*, 2017), and convenience sampling (Yeo *et al.*, 2017). We used a questionnaire, using Google Form, distributed in Italy between November and December 2020. A pre-test of 10 questionnaires was carried out, which were removed from the final sample. A sample size of 220 respondents was reached. The questionnaire was in Italian, and we informed the interviewees about the anonymity of the data before the start.

Research Design

The first was a filter question, which asked respondents if they had ever purchased anything online; if not, the questionnaire had been concluded (only 21 in our study). A final sample composed of 199 observations was analysed. The questionnaire consisted of two sections. A socio-demographic section (Table 1), in which the interviewees were asked about purchasing habits of food and wine products, age, gender, occupation, highest level of education, origin (Northern Italy, Central Italy, Southern Italy, Island) and residence (town centre, suburb, countryside). The second section included the research variables adapted from the study of Teo *et al.* (2004) and others, adjusted considering the products of our study (food and wine, i.e., groceries). All the scales were seven-point Likert scales. Appendix A shows each indicator definition, mean values and standard deviation.

In the uncertainty composite (U), we included both product uncertainty and behavioural (manufacturer's) uncertainty. For the first, six questions were asked, three for food and three for wine. These items measured how difficult it was to find good value for money, high-quality (Liang and Huang, 1998), and certified products (Scuderi *et al.*, 2019). We adapt four constructs from Eastlick *et al.* (1999) for behavioural uncertainty. Respondents were asked to what extent they have difficulty trusting sellers, finding responsive sellers, reliable information, and certified producers (i.e., who have received awards, and accolades). As mentioned above, asset specificity (As) was measured only in terms of human asset specificity, using a five-item scale.

Respondents were asked how much time they spent learning how to shop online (Joshi and Stump, 1999), comparing products online, and finding

trustworthy websites (Liang and Huang, 1998). Respondents were also asked, considering the nature of these products (food and wine), how much their habits would change if they started buying food and wine online. Frequency (F) was measured simply as how often respondents usually buy them online (Everaert *et al.*, 2010). Consumer interest (CI) was measured on a seven-item scale, three of which assessed the extent to which online shopping for food and beverages enabled consumers to search for hard-to-find products (Eastlick and Feinberg, 1999), and save time (Eastlick and Feinberg, 1999). One element was specific to wine: the extent to which online shopping allows respondents to purchase niche wines (biodynamic, sulphite-free, with wild yeasts). These three elements were related to the convenience dimension. The other four measured economic usefulness, so the extent to which buying food and wine online has made it easier for the consumer to take advantage of special discounts and coupons (Achadinha *et al.*, 2014), and save money (Eastlick and Feinberg, 1999). These two items were for both the products, while the other two were for wine only: the extent to which online shopping made it easier to find the best (possibly rare) and better-priced wines (Eastlick and Feinberg, 1999). Transaction costs (TC) were measured on a scale of six elements, three related to time spent searching for the right online stores and products, comparing and inspecting products, adapted by Liang and Huang (1998). One element was related to the time taken to trace the products shipped, adapted from Dahlstrom and Nygaard (1999). Another element was to the time spent understanding the information provided by the websites adapted from Stump and Heide (1996). The last one was shipping costs, adapted from Liang and Huang (1998). Six elements were used to measure willingness to buy (WTB), adapted from Dodds *et al.* (1991). Regarding the perceived discomforts due to Covid-19, we created an ad-hoc five-item scale using the study of Perdana *et al.* (2020) about the uncertainty created by the pandemic in the food supply network, and the study of Pressman *et al.* (2020) about the perceived security risks associated with the pandemic. Therefore, we asked how difficult it was for respondents to get food and drinks out, go to the store, find what they want at the store, find staff who respect the rules to prevent the spread of the disease, and wait to enter the supermarket.

Table 1 - Socio-demographic characteristics

Variable			***Total***
Responsible for Food Shopping			199
	Yes	87	
	Sometimes	96	
	No	16	
Have you ever buyed Food or Wine On-line?			199
	Yes	143	
	No	56	
Gender			199
	Male	83	
	Female	115	
	Not specified	1	
Age			199
	18-30	138	
	31-45	32	
	46-65	26	
	> 65	3	
Origin			199
	North	28	
	Centre	135	
	South	15	
	Islands	21	
Residence			199
	City centre	111	
	Subusrb	65	
	Countryside	23	
Education			199
	Below High School	1	
	High School	36	
	University and over	162	
Family members			199
	Single	36	
	2 members	65	
	3 members	38	
	4 members	40	
	> 4 memebers	20	
Occupation			199
	Not occupied	14	
	White-collar	94	
	Blue-collar	5	
	Self-employed	26	
	Soldier	1	
	Pensioner	1	
	Student	54	
	Not specified	4	

Source: Authors' elaboration.

3. Results

Measurement Model

Measurement and structural models were analysed using SmartPLS (Ringle *et al*., 2015). Confirmatory composite analysis (CCA) (Schuberth *et al*., 2018) was used to test the measurement model, which evaluates the relationships between constructs and indicator variables. First, indicators with factor loading below 0.5 were removed (Hair Jr *et al*., 2014). Then, we evaluated the composite reliability and Cronbach's alpha. Both the indices have as ideal cut-off 0.7 (Ramayah *et al*., 2018; Ringle *et al*., 2020). All the latent constructs of the model possess composite reliability (Table 2). The second component of the measurement model is the convergent validity, measured by the Average Variance Extracted (AVE). It reflects the average commonality for each latent factor in a reflective model, and the cut-off criterion value is 0.5 (Ramayah *et al*., 2018; Ringle *et al*., 2020). Thus, constructs possess convergence validity (Table 2). We also considered the constructs' discriminant validity, accessed through the Heterotrait Monotrait (HTMT) ratio procedure, Fornell-Larcker criterion, and cross-loadings. The most conservative threshold for the HTMT ratio is less or equal to 0.9 (Henseler *et al*., 2015). In our study, the HTMT ratio values are less than 0.9, so discriminant validity is attained (Table 3). The Fornell-Larcker criterion was also respected, and so were cross-loadings.

Structural Model

Table 4 shows the results of the structural model. H1 and H2 were both confirmed, showing that increasing U and As, the TC for the consumer increase ($\beta = 0.261$, $t = 3.703$, $p = 0.000$ and $\beta = 0.480$, $t = 7.885$, $p = 0.000$). This means that, when the consumers are uncertain about the bargain they are making or the specificity of the asset "know how to buy online" is perceived as high, the TC for buying groceries online increase. On the other hand, the effect of CI is neither significant nor negative, but it is of small magnitude ($\beta = 0.039$, $t = 0.392$, $p > 0.1$), rejecting H3. This means that this variable does not significantly affect the TC for the consumers and that they may not find convenient buy online.

The results also show that the direct relationship between TC and WTB, although negative, it is not significant ($\beta = -0.089$, $t = 0.989$, $p > 0.1$), rejecting H4. This means that TC do not have a significant impact on the decision of buying online. However, Covid-19 has had an interesting effect in this relationship. In fact, as the discomforts due to Covid-19 pandemic

Table 2 - Factor loadings, reliability and validity

	Λ	Alpha	CR	AVE
Uncertainty		0.909	0.924	0.578
U1	0.834			
U2	0.774			
U3	0.830			
U4	0.799			
U5	0.639			
U6	0.713			
U7	0.766			
U8	0.678			
U9	0.784			
Asset Specificity		0.749	0.857	0.670
As1	0.882			
As2	0.888			
As3	0.665			
Consumers' Interest		0.856	0.877	0.547
CI1	0.820			
CI2	0.616			
CI3	0.778			
CI4	0.840			
CI5	0.736			
CI6	0.617			
Transaction Costs		0.806	0.861	0.564
TC1	0.796			
TC2	0.884			
TC3	0.535			
TC4	0.570			
TC5	0.890			
WTB Groceries On-line		0.887	0.916	0.686
WTB1	0.816			
WTB2	0.768			
WTB3	0.810			
WTB4	0.882			
WTB5	0.859			
Covid discomforts		0.719	0.824	0.540
Covid1	0.772			
Covid2	0.679			
Covid3	0.692			
Covid4	0.790			

Source: Authors' elaboration.

Table 3 - Discriminant Validity using HTMT

	As	Covid	CI	TC	U
As					
Covid	0.347				
CI	0.143	0.232			
TC	0.658	0.363	0.135		
U	0.326	0.315	0.183	0.419	
WTB	0.089	0.221	0.545	0.093	0.132

Source: Authors' elaboration.

Table 4 - Hypotheses testing

	Path Coefficient	*Standard Deviation*	*T Statistics*	*P Values*
U -> TC	0.261	0.071	3.703	0.000***
As -> TC	0.480	0.061	7.885	0.000***
CI -> TC	0.039	0.100	0.392	0.695
TC -> WTB	-0.089	0.090	0.989	0.323
Covid -> WTB	0.204	0.089	2.285	0.022**
TC -> Covid	0.285	0.077	3.702	0.000***

*** p<0.01, ** p<0.05, * p<0.10
Source: Authors' elaboration.

increase, so does the perceived Transaction Costs ($\beta = 0.285$, $t = 3.702$, $p = 0.000$), confirming H6. On the other hand, as expected, the pandemic has had a significant effect on the WTB online ($\beta = 0.204$, $t = 2.285$, $p = 0.022$), confirming H5.

Mediation Analysis

For what may concern the mediation analysis, the results are presented on Table 5. H7 is confirmed, as the effect of TC on the WTB, with the mediation of the discomforts created by the Covid-19, is positive and significant ($\beta = 0.058$, $t = 1.828$, $p = 0.068$). Therefore, although TC do not

affect directly consumers' behaviour (WTB), the pandemic fully mediates this relationship, making it both positive and significant. Furthermore, it can be interesting to notice that the indirect effect of both U and As on the perceived discomforts due to Covid-19 is positive and significant, while their indirect effect on the WTB (with the mediation of the variable Covid) is positive, but significant only for As.

Table 5 - Mediation Analysis

	Total Effects		Direct Effects	
	Coefficient	*T Statistics*	*Coefficient*	*T Statistics*
TC -> WTB	-0.031	0.336	-0.089	0.989
	Indirect Effects			
	Coefficient	*Standard Deviation*	*T Statistics*	*P Values*
TC -> Covid -> WTB	0.058	0.032	1.828	0.068*
AS -> TC -> Covid	0.137	0.045	3.049	0.002***
U -> TC -> Covid	0.074	0.028	2.696	0.007**
As -> TC -> Covid -> WTB	0.028	0.017	1.673	0.094*
U -> TC -> Covid -> WTB	0.015	0.009	1.626	0.104

Source: Authors' elaboration.

Analysis with WarpPLS

The results were checked using non-linear PLS-SEM, provided by WarpPLS 7.0 (Kock, 2017), which implements a non-parametric algorithm called Warp3. This algorithm is like other PLS algorithms, calculating weights, loadings, and variable scores (Kock, 2017). The warping is performed at the path coefficient level, using a Robust Path Analysis technique (Kock, 2017). Table 6 presents all the Model Fit and Quality indices provided by WarpPLS (Kock, 2010, 2014) which confirm the global model fit (i.e., the model fit with the data).

Furthermore, the results for all the hypothesis were confirmed, including the mediation effect. The effect sizes provided are similar to Cohen's (1988) f-squared coefficients, but calculated through a different procedure to avoid a distortion inherent in the use of classic PLS-based SEM algorithms (Kock, 2014). With the effect sizes it is possible to assess whether the effects indicated by path coefficients are small, medium, or large. The cut-offs usually are 0.02, 0.15, and 0.35, respectively (Cohen, 1988). Values below

Table 6 - Model Fit and Quality Indices with WarpPLS

Coefficients	*Coefficient*	*P Values*
Average path coefficient (APC)	0.211	< 0.001
Average R-squared (ARS)	0.160	< 0.001
Average adjusted R-squared (AARS)	0.152	< 0.001
Indices	*Value*	*Cut-off*
Average block VIF (AVIF)	1.094	acceptable if <= 5, ideally <= 3.3
Average full collinearity VIF (AFVIF)	1.359	acceptable if <= 5, ideally <= 3.3
Tenenhaus GoF (GoF)	0.312	small >= 0.1, medium >= 0.25, large >= 0.36
Sympson's paradox ratio (SPR)	1.000	acceptable if >= 0.7, ideally = 1
R-squared contribution ratio (RSCR)	1.000	acceptable if >= 0.9, ideally = 1
Statistical suppression ratio (SSR)	1.000	acceptable if >= 0.7
Nonlinear bivariate causality direction ratio (NLBCDR)	1.000	acceptable if >= 0.7

Source: Authors' elaboration.

0.02 indicate very weak effects, too weak to be considered relevant (Kock, 2014). In our model, the ES for CI is below the threshold for the significance (0.001), meaning that this variable does not affect the perceived TC at all (Table 7).

Table 7 - Effect Size

	U	As	CI	TC	Covid	WTB
TC	0.102	0.252	0.001			
Covid				0.090		
WTB				0.004	0.031	

Source: Authors' elaboration.

Discussion

The first part of the study assesses the relationship between consumers' perceived transaction costs for online grocery shopping, their antecedents (As and U) and consumer interest (CI).

The results confirm H1 and H2, as well as the theory of transaction costs (Williamson, 1979, 1991), the findings of Marchini *et al.* (2021), and Teo *et al.* (2004). Which means that Uncertainty and Asset specificity are antecedents of transaction costs (Williamson, 1979, 1991; Teo *et al.*, 2004),

and, considering online shopping as an extremely decentralised purchasing form, it is confirmed that it is chosen when AS is low, as well as U (Marchini *et al.*, 2021). H3 is strongly rejected, meaning that both the convenience and the economic utility are not important determinants neither of TC nor of WTB, contrary to previous literature (Wigand, 1997; Eastlick and Feinberg, 1999; Teo *et al.*, 2004; Jiang *et al.*, 2011; Yeo *et al.*, 2017). It is probably because, unlike technologies, food is a particular category of product. As explained by Marchini *et al.* (2021), regarding groceries, consumers may find it difficult to trust and rely on decentralised forms of purchase. This is because food is a fundamental asset of the "health capital" (Marchini *et al.*, 2021). Thus, economic utility or convenience may not be as important as other aspects (such as, safety or quality) for food and wine purchase. This theory may also explain why the results obtained by Yeo *et al.* (2017) for take-away are, in this respect, so different from ours. In fact, this type of food is intrinsically characterised by components as speed and convenience, and it is a highly decentralized form of purchasing (Marchini *et al.*, 2021). Furthermore, if we consider CI as a proxy of some sort of "opportunistic" consumer behaviour (for example, they might think that buying the same product online instead of in the store can save money/time, at the expenses of sellers) it must be said that this may not apply to groceries. In fact, in Italy, shopping online for food is usually more expensive than going to the store. Major supermarket chains usually offer this service, but at a higher cost. Therefore, consumers may not find it convenient (or opportunistic) to shop online rather than in-store, as is the case with other products (such as books or technologies). For wine taken individually, however, the situation could be different, but in the present study it was analysed together with food, so we cannot know for sure. However, we must take into account the fact that discounts on wine in supermarkets can be attractive to the consumer.

Surprisingly, perceived transaction costs do not significantly impact willingness to buy food and wine online (rejecting H4), even if the sign is consistent with the theory (Williamson, 1979, 1991; Teo *et al.*, 2004; Marchini *et al.*, 2021). On the other hand, the perceived discomforts due to Covid-19 have a significant and positive impact on the WTB (H5), confirming that the pandemic has affected (at least as long as restrictions are imposed) consumption patterns (Gao *et al.*, 2020; Kim *et al.*, 2021). Furthermore, the results for H6 and H7 confirm that there is a relationship between perceived TC, discomforts created by Covid-19, and WTB food and wine online (Dannenberg *et al.*, 2020). In particular, the difficulties caused by asset specificity and uncertainty increase the perceived discomforts due to Covid-19. The pandemic (and its effects in everyday life) seems to act as a mediator in the relationship between TC and WTB food and wine online, possibly leading to a change in consumption patterns (Hobbs, 2020). In fact,

while from the results there is no significant relation between TC and WTB, Covid-19 has a direct effect on the propensity to purchase online (H5), and transaction costs have an indirect effect mediated by Covid-19 (H7). Thus, Covid-19 may lead to a shift towards online grocery purchase, despite the difficulties encountered during the process (uncertainty and asset specificity). Furthermore, the partial mediation between the antecedents of TC and the perception of the discomforts due to Covid-19 indicates that the difficulties encountered in buying food and wine online increase those perceived from the pandemic (Dannenberg *et al.*, 2020). Although this result is limited, it opens up several avenues of research. Three main questions should be answered soon: Will this effect last? Are there any other variables that can have an influence? What will be the effects on the food supply chain?

Conclusions

The current study seeks to assess the role of the Covid-19 pandemic on the relationship between TC and WTB food and wine online. From the results, transaction costs seem not to impact the WTB significantly, but the sign is correct. Furthermore, the study tries to establish whether TCT can also be applied to the online purchase of food and wine products. From the results, the theory holds for these products, although the role of frequency is uncertain. On the one hand, the sign of the relationship is right, confirming the TCT. On the other hand, the relationship is not significant.

From a managerial standpoint, these findings can help those manufacturers struggling with low-performing e-commerce during the Covid-19 pandemic. When restrictions are enforced, manufacturers should take actions to reduce the uncertainty associated with online shopping. As for the specificity of the assets, we should intervene with websites designed ad-hoc, making the experience more accessible for the consumer and more understandable. Furthermore, to avoid the difficulties generated by checking multiple websites and buffer the costs for their creation, producers (especially if local) could join forces and create shared and user-friendly platforms.

The main limitation of this study was the composition and sample size, although we used bootstrapping to compensate for this bias partially. First of all, the sample comprises many young graduates who certainly know the online tool more than other population segments. It would therefore be interesting to analyse the results on different socio-demographic contexts. Another limitation concerns the geographical distribution of the sample, which is mainly concentrated in central Italy. Furthermore, consumption patterns are generally country-specific, so it is not easy to generalise these results. However, the possibilities for new researchers are endless. In fact,

given the pandemic's effect on consumer behaviour, it may be interesting to study whether it will last or change (at least for some categories of consumers) and, if so, for which ones. Furthermore, the same study could be conducted in a comparative way, similar to that of Teo *et al.* (2004). It might also be interesting to study the same phenomenon for purchasing local food and short supply chains.

The main implication for all the actors in the supply chain (plus politicians) is that probably there was a change in consumption and purchase pattern. While in other countries shopping online has long been a widespread behaviour, as seen in the introduction, Italy seems to be reluctant to this type of change. The reasons, as previously illustrated, are different and involve logistical problems, the cultural and social background. However, the consumers after the advent of Covid-19 may change this perspective, so much so that they do not "allow" the transaction costs to impact their purchasing behaviour as much as the inconvenience due to Covid-19. In any case, if at the end of the pandemic a good part of consumers will return, or rather, continue to buy in stores, a slice could decide to continue shopping online or to adopt a hybrid purchasing regime (to recall Williamson's theory). In both cases, there would be a change in buying patterns. There is no doubt that Covid-19 has changed our behaviour.

From a political point of view, according to our study results, sellers should be helped (practically and economically) to adapt to the possibility of selling, primarily online. It could be crucial to reach a broader consumer base and intervene in times of crisis like this. The creation of institutional platforms where small and local producers can easily organise the distribution using technological means could reduce the costs associated with creating and maintaining an e-commerce channel. In conclusion, we do not know what our future "normality" will be like, but it will probably include more digitalisation and online shopping, even for food and wine; so, it may be the right time to start thinking about solutions that are as practical as they are (perhaps) essential.

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Appendix

Appendix A. Indicators' definition

Uncertainty	Mean	Min	Max	SD
It was difficult to find certified producers/sellers	3.18	1.00	5.00	1.48
It was difficult to find responsive sellers	3.44	1.00	5.00	1.59
It was difficult to find reliable information	3.45	1.00	5.00	1.45
It was difficult to trust the producers/sellers	3.05	1.00	5.00	1.44
It was difficult to find certified products(food)	2.88	1.00	5.00	1.56
It was difficult to find high-quality food	3.11	1.00	5.00	1.54
It was difficult to find certified wine	2.71	1.00	5.00	1.62
It was difficult to find qualified wine producers	2.92	1.00	5.00	1.50
It was difficult to find high-quality products (wine)	2.79	1.00	5.00	1.55
Asset Specificity				
I spent a lot of time comparing products	3.34	1.00	5.00	1.67
I spent a lot of time searching for trustworthy websites	3.47	1.00	5.00	1.56
I spent a lot of time learning how to shop online	2.06	1.00	5.00	1.30
Consumers' Interest				
Online shopping allows me to buy hard-to-find products	4.86	1.00	5.00	1.90
Online shopping allows me to save time	5.01	1.00	5.00	1.91
Online shopping allows me to use coupons and discounts	4.43	1.00	5.00	1.81
Online shopping allows me to buy niche wines	4.54	1.00	5.00	1.82
Online shopping allows me to buy the best wines	4.03	1.00	5.00	1.80
Online shopping allows me to buy better-priced wines	3.92	1.00	5.00	1.69
Transaction Costs				
I spent a lot of time comparing products	3.00	1.00	5.00	1.54
I spent a lot of time inspecting products	4.07	1.00	5.00	1.67
I found ship charges very high	3.62	1.00	5.00	1.61
I spent a lot of time tracking my shipped products	3.20	1.00	5.00	1.57
I spent a lot of time understanding website info	3.67	1.00	5.00	1.59
WTB Groceries On-line				
I want to buy food online	3.36	1.00	5.00	2.17
I will buy food online	3.26	1.00	5.00	2.05
I would like to buy wine online	3.37	1.00	5.00	1.99
I want to buy wine online	3.26	1.00	5.00	2.06
I will buy wine online	3.20	1.00	5.00	1.97
Covid discomforts				
During Covid-19 was difficult to find what I want at the store	2.57	1.00	5.00	1.46
During Covid-19 going to the store was difficult	3.11	1.00	5.00	1.66
During Covid-19 was difficult to find store's personnell who respected prevention rules	2.89	1.00	5.00	1.51
During Covid-19 was difficult to wait outside the store	3.22	1.00	5.00	1.61

Source: Authors' elaboration.

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Differences between Italian specialty milk in large-scale retailing distribution

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Abstract

The specialty milk market in Italy has shown positive trends in recent years. Companies, from small producers to market leaders, continue to invest in differentiating their product lines, increasingly orienting their production choices towards specialties linked to sustainability and health benefits. This trend not only meets the needs of consumers, who are increasingly attentive to sustainable and healthy foods, but it also has a significant impact on the production and profitability of milk companies. Thus, this research aims to analyse the composition of specialty cow milk assortments in different large-scale retail (LSR) stores in North-West Italy. The objectives were to define the assortment depth of sustainable and health-focused milk categories, as well as the marketing policies currently applied in the LSR market for such products. Differences in the assortment of seven specialty product categories were evaluated with regard to brands, milk origin and packaging material, using the Correspondence Analysis. Price differences between product categories were analysed using ANOVA and comparing the product brands and the different formats of large-scale retailers. The main results highlight the key characteristics and differences of the specialty milk supply, taking into consideration the main sales channel of this type of product.

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Introduction

Consumer interest in sustainable and healthy products has increased due to environmental and nutritional concerns (Imami *et al*., 2017; Magan *et al*., 2021). Despite the negative scenario that has characterised the cow milk market in recent years, milk consumption over the last two years has shown signs of recovery, with consumers increasingly orienting their choices towards sustainable (local and organic) and health-focused product varieties (ISMEA, 2019, 2021a). Over the last five years, there has been a 7% decline in the amount of milk purchased by Italian households; this decrease in consumption mainly affects fresh milk, followed by long-life milk (Ultra High Temperature - UHT treated milk) (ISMEA, 2019a, 2021a, 2021b). In addition, after signs of recovery in UHT milk consumption during the Covid-19 pandemic, the consumption trend resumed its decline in 2020/2021 (ISMEA, 2021c). This trend may have been instigated by claims regarding the negative effects of cow's milk on human health (Haug *et al*., 2007) and on the environment (Bava *et al*., 2014; Capper and Cady, 2012; Castanheira *et al*., 2010), which have seen consumers reduce/eliminate their milk consumption or choose alternative protein sources (Haas *et al*., 2019).

In this sense, according to the Ismea-Nielsen Consumer Panel Service data recorded at the Italian national level, the drop in milk consumption was partly influenced by the emergence of new healthy eating styles and more environmentally and ethically sustainable production choices, rather than by economic ones (Haas *et al*., 2019; Rizzo *et al*., 2020; ISMEA, 2021a, 2021b). In fact, the economic crisis that marked the period from 2015 to 2020 only partially affected milk consumption trends, with a shift towards lower cost distribution channels such as discount stores. At the same time, several studies have shown how food choices, even in the case of milk, are closely related to the socio-demographic characteristics of consumers (Gulseven, 2018). A recent study conducted by ISMEA (Institute of Services for the Agricultural Food Market) in 2019 (ISMEA, 2019b) showed that, on average, 33% of consumers surveyed in this research do not consume milk; this proportion rises progressively as the age of the subjects increases, reaching 42% between the ages of 55 and 64. Among the under-18s, the proportion of those who gave up milk was much lower. Given that the Italian population is ageing and decreasing (ISTAT, 2021), the decline in milk consumption could be a result of this negative demographic trend.

However, in a context of general decline, the specialty milk categories have followed a positive trend. Highly digestible milk or lactose-free milk has undergone exponential growth with a 47% increase in purchases over the last five years, thanks both to a doubling of the number of purchasing

households and a significant expansion of the range and product types offered on the shelves (ISMEA, 2021a, 2021b). Functional (enriched) and organic milk specialities – respectively linked to healthiness and sustainability – and lactose-free products, are currently very appealing to consumers (Rama, 2019). In relation to certified organic cow's milk, numerous research projects reveal that consumers recognise this product as being a more sustainable alternative, linked to the local production area and to traditional farming systems (Carfora *et al*., 2019; Gambelli *et al*., 2003; Scotti *et al*., 2015). Moreover, as revealed by a recent study on milk consumer preferences carried out in North-West Italy (Tabacco *et al*., 2021), in a sample of 502 consumers, around 30% of individuals identified organic certification and local production as important drivers of their choice of milk.

Italian production of organic milk exceeds 300 million litres (about 2.7% of the total milk produced), with a value of 158 million Euros (equal to 3.5% of the national BPP, i.e. the base product price) and a premium price of 28% more than conventional milk (De Ruvio, 2016). On the other hand, household expenditure on organic dairy products in large-scale retail (LSR) chains is worth more than 100 million Euros, with these products representing about 12% of the total sales of certified food products in this distribution channel.

Functional or 'enriched' and/or 'flavoured' milk – i.e. supplemented with nutrients that can positively influence health, prevent pathological conditions or have therapeutic functions – suffered a 4.1% decrease in average price and 0.2% reduction in volumes before 2020. As explained by Rama (2019), this trend may be attributable to the growth in the share of hard discounters, where lower prices are usually recorded and for which there was a 15.9 % increase in volumes sold on an annual basis.

Since the first half of 2019, there has been an increase in purchases of 9.2%; this indicates that a recovery is currently underway, highlighting the emergent interest of consumers in functional products, such as those with added omega 3, vitamins, etc. In recent years, the increasing of selling price of these products has led producers – from small companies to leading brands – to differentiate themselves by creating various lines of functional products. In general, cow's milk producers have invested a great deal of resources in achieving more sustainable production systems and, at the same time, establishing brand repositioning strategies; they have done this by focusing on product categories considered more in line with consumer needs and following drivers of choice linked to product sustainability and healthiness (Redazione Dairy, 2020a).

Background

Despite the numerous scientific publications on consumer preferences, perception, and choice orientations towards specialty milks such as organic and functional/enriched (Ares *et al*., 2009a; 2009b; Dekker *et al*., 2019; Palacios *et al*., 2009; Peng *et al*., 2006; Rizzo *et al*., 2020), to the best of our knowledge, few studies have been carried out on the supply characteristics of specialty cow milk in Italian distribution channels (Trestini and Stiletto, 2020). This research focuses on the comparison between different types of product attributable to the milk specialties category by applying statistical techniques of investigation and comparison already adopted in our previous research dedicated to conventional milk (Merlino *et al*., 2021). In particular, the comparative approach described in Merlino *et al*. (2021) made it possible to describe and compare some characteristics of the different products considered in detail.

The decision-making process underlying product assortment planning in large-scale retail is fundamentally important to a product's success on the market. The marketing choices on which assortment planning decisions are based, such as size, depth, positioning, window display, etc., change periodically considering each storage unit and the different LSR formats (Mantrala *et al*., 2009; Merlino *et al*., 2021). Indeed, as revealed by Merlino *et al*. (2021), product characteristics linked to marketing components (product, promotion, price and positioning) change considerably in the composition of the assortment, depending on the format (of the large-scale retail trade), product line and geographical area, in line with consumer demands, which are also heterogeneous in the different geographical contexts. For example, when considering different LSR formats, the product assortment changes from supermarkets, where there is a large assortment with low to medium prices, to discounters, where the level of service and quality of product display decreases in favour of more competitive prices, up to hypermarkets, characterized by a wide assortment with medium prices. In addition, convenience stores, which focus their offer on small-scale, locally marketed products with a higher price and service level, are becoming popular in large Italian cities (Chernev, 2011; Solgaard and Hansen, 2003).

Data reported in Rama (2019) showed that lactose-free and enriched milks have increased their share of purchases in recent years, mainly at hard discounters, at the expense of hyper/supermarkets. The assortment planning process is complex because, in addition to considering market dynamics – whose complexity depends on the nature of the product – they depend on the demands of end consumers (Dhar *et al*., 2001). This is closely linked, amongst other things, to the opinion individuals have of the brand. Therefore, the brand directly influences the credibility and safety of the product.

Given these premises, this research aims to analyse the assortment of specialty milks by examining the products marketed in various stores of large-scale retail chains in North-West Italy. In particular, the goal is to define the assortment depth (A_{depth}) considering different categories of specialty milks and to compare factors related to product sustainability (Merlino *et al*., 2021). In detail, the A_{depth} was compared considering the product brand, origin and packaging. These three product features have been considered as factors characterising specialty milk sustainability for the following reasons:

- in the case of local origin, it can be considered an indicator of sustainability by consumers as it is synonymous with short supply chain, a concept that simultaneously embodies the three pillars of sustainability: environmental, social and economic (Annunziata & Mariani, 2018; Aprile *et al*., 2016; Balboni, 2017; Bentivoglio *et al*., 2019; Wang *et al*., 2019);
- the brand of a product combines the name, logo, slogan, storied communication and reputation. It is also a distinctive sign for the company that encompasses images and values, such as sustainability (Chen *et al*., 2017; Grubor & Milovanov, 2017);
- packaging material is an important feature supporting product sustainability from the consumer perspective and its enhancement is a continuous challenge for the food producer (Chen *et al*., 2019). However, recent research carried out on consumers' milk packaging preferences (Merlino *et al*., 2020) found that consumers do not consider packaging to be an important driver when choosing products, but that they would be willing to pay a premium price for more sustainable packaging for milk and a high service value.

Lastly, specialty prices were evaluated by comparing different formats and brand categories to ascertain the price policies used by milk producers.

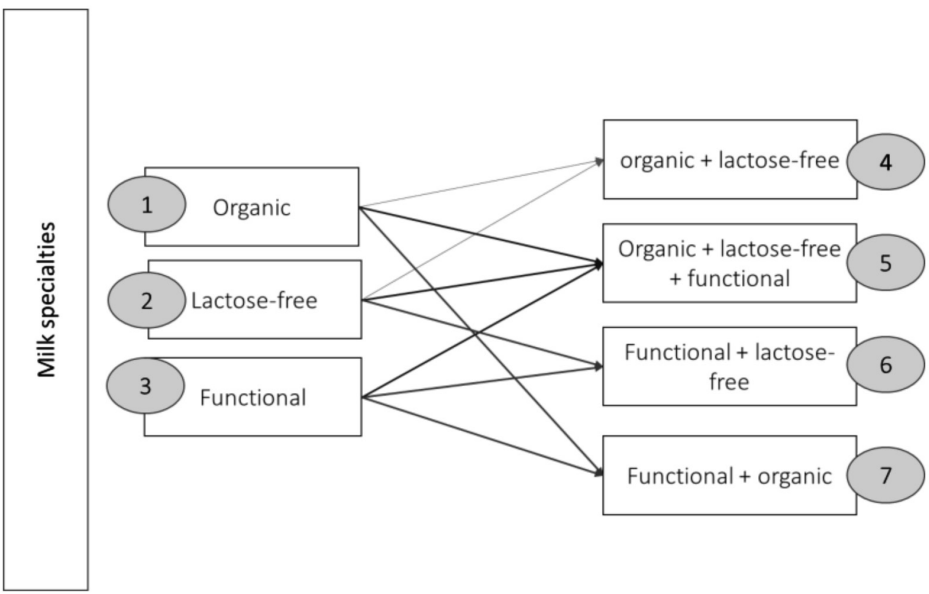
1. Materials and methods

Sampling

All information on the products that make up the cow's milk portfolio in the milk specialty categories was collected by visiting 52 points of sale of 8 different large-scale retailers (LSR), including hypermarkets, supermarkets, convenience stores and discount stores in North-West Italy (Piedmont and Lombardy regions). The considered area plays an important role in the national production of cow's milk; in fact, 53.5% of the milk produced in Italy comes from these two regions (ISMEA, 2021d; OMPZ, 2020). The survey period focused on March to June 2019. In particular,

the assortment depth (A_{depth}) (which is the number of product variants or items, references or stocked units – SKUs – within a product category with separate designations in the offer price list) of seven product lines (Merlino *et al*., 2021) was examined. Each item was assigned to a milk category, numbered from 1 to 7, following the classification criterion reported in Figure 1. Starting from the three main categories of speciality milks on the market, the references analysed in the shops were allocated to the three groups (1, 2 and 3) only if they were characterised by just one of the following features: being (1) organic, (2) lactose-free, or (3) functional. In particular, the "organic" category included all milk products originating from organic farms (EC 834/2007; EC 889/2008), while "lactose-free" included all products whose label contained the words "no lactose", "0 lactose" or "lactose-free". As the point-of-sale analysis revealed that many products included several characteristics at the same time (e.g. they were both organic and lactose-free), we created sub-categories by matching the three main product categories in different combinations (Figure 1).

Figure 1 - Classification criterion used to group and code specialty milk products into the seven categories



Finally, the "functional" group included all products with at least one of the claims listed in Table 1.

Table 1 - Label claims considered for classifying functional milk

Label claim*
–30% of sugar, with fibre (Inulin) and vitamins A and D3
–30% of sugar, source of magnesium and vitamins B6 and B12
–30% of sugar, source of protein
Enriched with vitamins A and D3
With vitamin D
1.6% fat
30% less sugar
34 kcal
With cocoa
With green coffee and ginger, lactose-free
With ginseng and liquorice, lactose-free

* The presence of at least 1 or more of the following claims concurrently on the label meant the product was included in the "functional/enriched" category.

For each SKU the origin, brand, packaging materials and price features were collected from all considered outlets (Table 2).

Table 2 - Product characteristics collected for all milk products sold at the different stores of large retail chains

Characteristic	**Definition**
Origin	National, regional, EU, non-EU, other countries
Packaging material	Plastic, glass, laminated composite material
Brand	Distributor Brands or private label (DB), Leading producer brands (L) and Other Producers/brands (OP)
Price	Single price for each item

The brands were categorised into Distributor or Private label (DB), Leading producer brands (L) and Other Producers/brands (OP) following the criteria used by the Italian Dairy Association (Assolatte, 2018), already used in recent research by Merlino *et al*. (2021).

Statistical analysis

In order to describe the association between the different milk specialty categories (from 1 to 7, see Figure 1) and the different product variables (origin, packaging material and brand), a series of Correspondence Analyses (CA) were conducted by analysing [specialty categories x brand category], [specialty categories x packaging material] and [specialty categories x milk origin].

CA is a statistical technique used to identify patterns and associations between category variables and simultaneously to organise them graphically with the considered specialty categories (nominal variables) in the same dimensional space (Ayele *et al*., 2014; Lana *et al*., 2017; Merlino *et al*., 2021). The CA draws the frequency points of rows and columns of a contingency table in a same geometric space, constructing the data representation in an area structured by a chi-square distance; it then continues by representing the variables on the basis of the identified principal components (axes) (Ayele *et al*., 2014; Beldona *et al*., 2005; Gursoy and Chen, 2000). In the map, greater proximity between the points highlights a higher proportion associated with the different levels of rows and columns. Furthermore, this technique allows the number of prevalent dimensions to be determined based on the different associations of multinomial variables (Beldona *et al*., 2005; Gursoy and Chen, 2000; Harcar and Spillan, 2006). In this research, singular values greater than 0.20 were considered (Hair *et al*., 1998). In the results' section, all eigenvalues (estimated dimensions, single values, inertia, and the proportion explained by each dimension) were reported. Therefore, this technique provides a complete view of the data for effective interpretation.

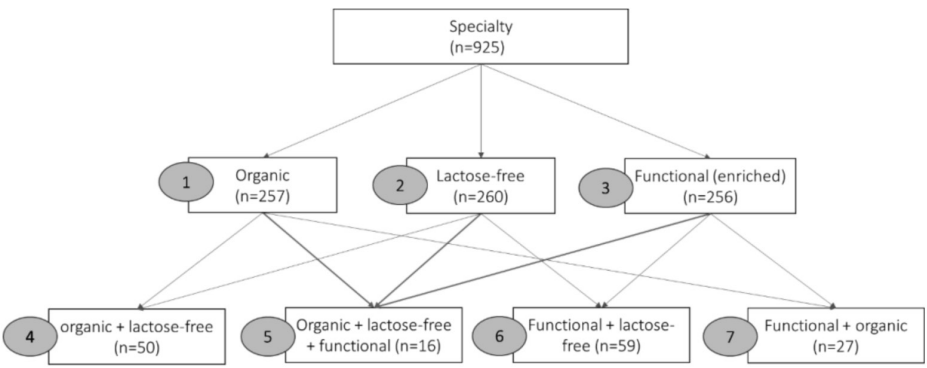
This technique is widely used in the scientific literature, and the theoretical properties of CA can be further explored by external consultation (Beldona *et al*., 2005; Fotuhi *et al*., 2019; Greenacre, 2017). The Analysis of Variance (ANOVA) test was performed to verify the H0 (there were no significant differences in the average prices of milk specialty groups across the different formats in large retailers) and the H1 (there were no significant differences in the average price of milk specialty groups considering the different brand groups). We performed several two-way ANOVAs in order to test the main effect and interaction effects of milk specialties (7 categories) with each of the other independent variables (LSR formats – 4 levels, and brand groups – 3 levels) on the average milk price (dependent variables). The ANOVA is able to identify the difference between the mean values, but not to specify the relationship between the averages. However, the calculation of main effects and interactions, used to explain the pattern of relationships between the averages, enabled us to minimise this methodological limitation (Buckless & Ravenscroft, 1990).

All statistical analyses were performed using SPSS 27.0 for Windows.

2. Results and Discussion

The analysis of data on the composition of the supply of cow's milk in different LSR stores reveals the great competitiveness of specialty milk in the drinking milk sector. Indeed, the portfolio of cow's milk specialities consisted of 925 product items. The three main product categories with only one classification criterion (only organic, only lactose-free, only functional) were equally distributed in terms of A_{depth}. From the product categories that were characterised by the presence of more than one product classification, the most important group in terms of A_{depth} was category 6 (functional and lactose-free), followed by category 4 (organic and lactose-free) (Figure 2).

Figure 2 - Composition of the cow's milk portfolio. All specialty categories considered with their depth (A_{depth}) are described



These initial results reveal that the lactose-free characteristic is the most recurrent in the sample, confirming that this product characteristic appears in an increasingly wide range of milk categories, and dairy products in general (Dekker *et al*., 2019). As reported in a survey published online (Food, 2019), in addition to the simple free-from claim, consumers reward the combination with other pluses. However, our results show that the A_{depth} of products with multiple claims (lactose-free + other) is much smaller than that of products coded as 1, 2 and 3.

The results of the Correspondence Analysis on the association between brand groups and milk specialty categories (brand groups x specialty categories) are described in Figure 3. The eigenvalues (estimated dimensions, single values, inertia and proportion explained by each dimension) are given in Table 3.

Table 3 - Correspondence analysis (brand categories x specialty categories). The chi square of independence between the two variables (columns and rows) and the p-value are also reported

Dimensions	Singular value	Inertia	Proportion explained %	Cumulative proportion %	Chi Square	Sign.
1	**0.548**	**0.301**	**0.986**	**0.986**		
2	0.064	0.004	0.014	1.000	260.988	***
Total		0.305	1.000	1.000		

The accepted dimensions are highlighted in bold. The p-value refers to the statistical significance level: *** <0.001, ** <0.01, * <0.05; no value when not significant.

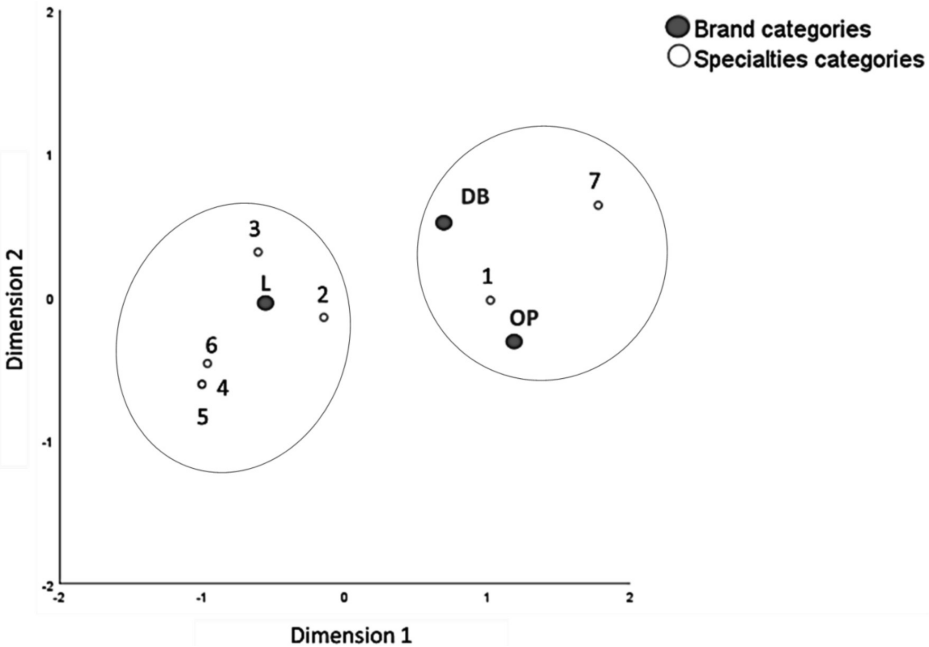
In this case, according to Hair *et al.* (1998), a one-dimensional solution can be accepted. In particular, dimension 1 shows the largest relative contributor to the total variance (98.60%) of the axis.

As shown in Figure 3, the "functional" and "lactose-free" milk specialties, even in their combinations, follow the same position and seem to be associated with leading brands (L). Consequently, the "organic" and "organic and functional" categories are mainly associated with brands of smallholder producers (OP) and retailers (DB).

These results show that leading brands focus on differentiating their products, mainly promoting milk products with healthy characteristics that meet the needs of consumers having intolerance problems or looking for a product with health benefits. Market leaders thus seem to focus on improving their own reputation by investing in products that are beneficial to consumers, which is currently also the most attractive and fastest growing market segment (Redazione Dairy, 2020b).

In contrast, both smallholder producers and retailers plan their specialty milk supply by offering primarily certified organic milk, some of which is also functional. It can therefore be inferred that the communication of the certified organic production – often linked to the environmental, social and economic sustainability by the consumer (Naspetti *et al.*, 2021; Schiano and Drake, 2021) – is the strength of private labels and small companies, differentiating them from leading producers. The effect of value and retailer brand loyalty is stronger for consumers who frequently choose the same categories of purchased products (such as regular products like milk) (Merlino *et al.*, 2021; Morales *et al.*, 2005); this is also true in the case of retailer-branded organic milk, hence. This confirming that the product differentiation strategy can improve brand reputation, particularly for small producers (Chernev, 2011; Hoch and Lodish, 1998). The decision of the

Figure 3 - Correspondence Analysis (brand categories x specialty categories)



OP = other producers; **L** = leader brands; **DB** = private labels; **1** = organic; **2** = lactose-free; **3** = functional (enriched); **4** = organic and lactose-free; **5** = organic, lactose-free and functional; **6** = functional and lactose free; **7** = functional and organic.

"other producers" category to focus on organic certification, rather than on functional milks, could be due to the high degree of complexity involved in investing in R&D and technology upstream of enriched or free-from milk production (Dekker *et al*., 2019; Fatkullin *et al*., 2021). This result could also be interpreted as the response of small producers to the low margins and high uncertainty (mainly related to low competitiveness against the major players) that characterise the conventional milk market, in addition to the strong increase in consumer demand for organic food products (Antonioli *et al*., 2019).

The extraction of the dimensional solution for the Correspondence Analysis between the variables (milk origin indication x specialty categories) considers two principal dimensions (axes) which account for 92.6% of the total variance (Table 4) as significant (following the limits of singular values greater than 0.20) (Hair *et al*., 1998).

Table 4 - Correspondence analysis (milk origin indication x specialty categories). The chi square of independence between the two variables (columns and rows) and the p-value are also reported

Dimensions	Singular value	Inertia	Proportion explained %	Cumulative proportion %	Chi Square	Sign.
1	0.318	0.101	0.641	0.641	134.957	***
2	0.212	0.045	0.285	0.926		
3	0.081	0.007	0.042	0.967		
4	0.070	0.005	0.031	0.998		
5	0.017	0.000	0.002	1.000		
Total		0.158	1.000	1.000		

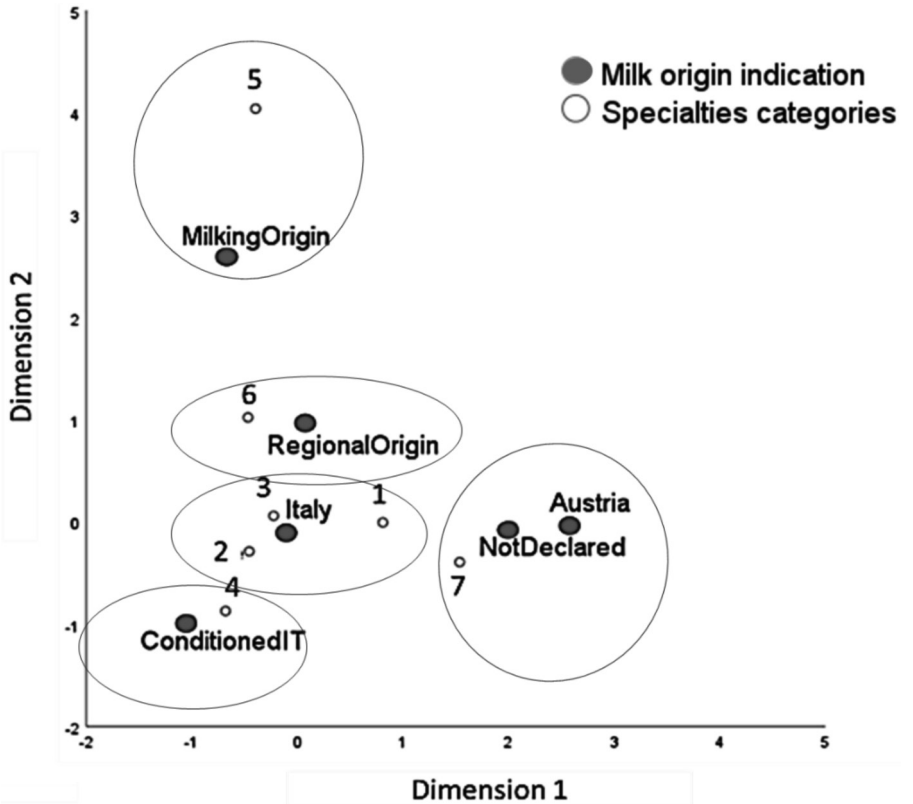
The accepted dimensions are highlighted in bold. The p-value refers to the statistical significance level: *** <0.001, ** <0.01, * <0.05, no value when not significant.

As can be seen from Figure 4, there is a high association between specialty categories 1, 2, 3 and national origin. This is an interesting result which reveals that milk producers have disclosed the country of origin of the milk on the label, despite the fact that, for most of these functional products (they are mostly UHT) and for organic products, there is no such regulatory obligation; a generic origin, such as "EU countries", can be indicated. This is in line with the result of a great deal of research carried out even nationally, which found that the indication of national origin is the most important attribute of choice for cow's milk (Tabacco *et al*., 2021; Tempesta and Vecchiato, 2013).

By contrast, the association between the most complex product category (5) and "functional and lactose-free" (6), with the origin of the indication of the milking process and the indication of regional origin, respectively, is quite surprising. In the latter case, companies aim at product differentiation while promoting the health benefits of the functional product for consumers and the regional/national origin of the product. While UHT was initially the only lactose-free option on the market, the range is now also growing in the refrigerated section, indicating continued growth of the segment. Additionally, inspired by the high quality national/regional origin of these products, households are increasingly switching to lactose-free dairy products when a single member is lactose intolerant, driving sales in this segment (Dekker *et al*., 2019).

Conversely, product categories where organic certification is associated with other characteristics (e.g. functional or lactose-free milk) originate mainly from European countries.

Figure 4 - Correspondence Analysis (milk origin indication x specialty categories)



ConditionedIT = EU origin, conditioned in Italy; **Austria** = Austrian milk origin; **Italy** = Italian milk origin; **RegionalOrigin** = indication of the Italian region of milk origin; **MilkingOrigin** = indication of the region or area of product milking; **NotDeclared** = milk origin not declared on the label; **1** = organic; **2** = lactose-free; **3** = functional (enriched); **4** = organic and lactose-free; **5** = organic, lactose-free and functional; **6** = functional and lactose free; **7** = functional and organic.

From analysing the correspondence between "packaging materials x specialty categories", a one-dimension solution emerged as significant, accounting for 98.7% the total variance (Table 5).

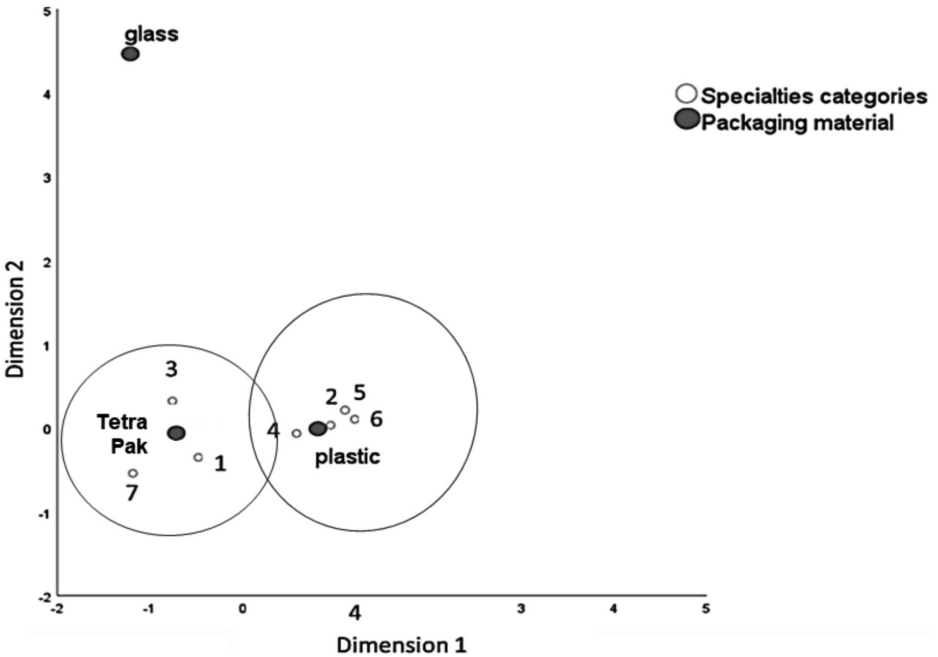
Figure 5 shows the net grouping of specialty categories 4, 5, 6 and 2 associated with plastic packaging material. In parallel, categories 3, 1, and 7 appear to be associated with laminated composite material (i.e. Tetra Pak). As a counter-trend, glass material (the minority of material used for packed milk) is only associated with the "functional" product. Although glass is positively correlated with environmental sustainability and consumer

Table 5 - Correspondence analysis (packaging materials x specialty categories). The chi square of independence between the two variables (columns and rows) and the p-value are also reported

Dimensions	Singular value	Inertia	Proportion explained %	Cumulative proportion %	Chi Square	Sign.
1	**0.628**	**0.395**	**0.987**	**0.987**		
2	0.071	0.005	0.013	1.000	341.859	***
Total		0.400	1.000	1.000		

The accepted dimensions are highlighted in bold.
The p-value refers to the statistical significance level: *** <0.001, ** <0.01, * <0.05, no value when not significant.

Figure 5 - Correspondence Analysis (milk packaging x specialties categories)



Glass = milk packaging in glass bottle; **plastic** = milk packaging in plastic bottle; **Tetra Pak** = milk packaging in laminated composite material container; **1** = organic; **2** = lactose-free; **3** = functional (enriched); **4** = organic and lactose-free; **5** = organic, lactose-free and functional; **6** = functional and lactose free; **7** = functional and organic.

perception in terms of quality and tradition (Centrale del Latte di Torino, 2019), the logistical issues associated with its use mean it is rarely used for milk packaging. While for conventional milk, plastic is still the main packaging material used (Merlino *et al*., 2021), speciality milks largely use laminated composite material, followed by plastic. However, differences emerge between the various product categories, demonstrating that functional and organic milks are those most associated with laminated composite material, while the use of plastic is associated with lactose-free milk. In this case, the association between the use of laminated composite material and organic milk is in line with the needs of Piedmont consumers, who are interested in organic milk (Tabacco *et al*., 2021) and its sustainability in relation to the possibility of recycling and the environmental sustainability of the packaging (Merlino *et al*., 2020).

The price analysis in the various categories of specialty milk revealed significant differences when comparing both LSR formats and brand categories.

In particular, as shown in Table 6, the organic, functional and lactose-free categories appear in all the analysed formats, while the other categories reveal a lower A_{depth}, even amounting to 0 in discounters for products 7 and 4. Considering the average prices of the different categories (Table 6), higher prices can be seen for groups in which the various characteristics (claims) are combined (groups 4 to 7), compared to products belonging to groups 1, 2 and 3 (organic, functional and lactose-free only).

This result is understandable given the greater complexity, including technological issues, that characterises more expensive products (Dekker *et al*., 2019). Among the specialties in groups 1, 2 and 3, the category that has the highest average price is functional milk, which is priced about 40% higher than the conventional product marketed in the same geographical area (Merlino *et al*., 2021). This price differential is in line with the average recorded in literature, where the lactose-free product was found to be 4 to 166% more expensive than conventional milk (Świąder *et al*., 2020) (Suri *et al*., 2019).

As described in Table 7, the ANOVA analysis demonstrates that it was largely the single effect of the "format" that significantly influenced price differences between the various categories, except in the case of the main effect of the "functional" variable.

Table 6 - Average price (€/l) recorded for each category of specialty milk comparing the formats in large-scale retail chains (LSR)

Format	Organic		Lactose-free		Functional		Organic and functional		Lactose-free and organic		Lactose-free, organic, functional		Lactose-free and functional	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Discount	1.190 (n=4)	0.209	0.985 (n=6)	0.266	1.911 (n=2)	0.322	/	/	1.259 (n=3)	0.125	/	/	1.265 (n=5)	0.026
Hypermarket	1.582 (n=113)	0.340	1.402 (n=110)	0.423	1.810 (n=161)	0.660	1.556 (n=10)	0.058	1.885 (n=30)	0.095	1.855 (n=10)		1.756 (n=30)	0.395
Convenience store	1.705 (n=39)	0.814	1.534 (n=27)	0.477	1.624 (n=20)	0.519	1.520 (n=7)	/	1.965 (n=5)	0.065	2.04 (n=1)	/	1.630 (n=7)	0.493
Supermarket	1.621 (n=101)	0.534	1.440 (n=117)	0.431	1.833 (n=73)	0.717	2.860 (n=10)	1.628	1.97 (n=12)	0.197	2.50 (n=5)	/	1.803 (n=17)	0.188
Total mean	1.610 (n=257)	0.514	1.425 (n=260)	0.432	1.806 (n=256)	0.666	2.110 (n=27)	1.173	1.910 (n=50)	0.134	1.892 (n=16)	0.233	1.736 (n=59)	0.271

Table 7 - ANOVA results: effect of each specialty category, format and interaction of product price

Factors	Independent variable	df	Quadratic mean	F	Sig.	Partial η2
Organic vs. format	Format	3	1.236	4.341	***	0.004
	Organic	2	7.313	25.688	***	0.150
	Format * Organic	5	0.384	1.347	0.241	0.002
Lactose-free vs. format	Format	3	1.691	5.827	***	0.005
	Lactose-free	3	0.809	2.788	*	0.020
	Format * Lactose-free	6	0.309	1.065	0.381	0.002
Functional vs. format	Format	3	0.325	1.164	0.322	0.001
	Functional	1	5.966	21.357	***	0.050
	Format * Functional	3	0.593	2.122	0.095	0.002
Functional and organic vs. format	Format	3	7.564	26.179	***	0.023
	Functional and organic	2	0.855	2.960	0.085	0.001
	Format * Functional and organic	1	3.073	10.635	***	0.006
Functional and lactose-free vs. format	Format	1	1.691	5.837	**	0.002
	Functional and lactose-free	3	5.557	19.188	***	0.017
	Format * Functional and lactose-free	2	0.124	0.428	0.652	0.000
Lactose-free and organic vs. format	Format	3	5.557	19.188	***	0.017
	Lactose-free and organic	1	1.691	5.837	*	0.002
	Format * Lactose-free and organic	2	0.124	0.428	0.652	0.000
Functional, organic and lactose-free vs. format	Format	3	5.575	19.189	***	0.017
	Functional, organic and lactose-free	1	0.676	2.328	0.127	0.001
	Format * Functional, organic and lactose-free	1	0.026	0.089	0.765	0.000

The p-value refers to the statistical significance level: *** <0.001, ** <0.01, * <0.05.

These results explain how the type of functional/enriched products significantly affects the average price revealed in the different LSR formats. The interactions between variables are not significant, except in the case of "Format * Functional and Organic". In particular, discounters market products in the different categories, generally at the lowest price, except in the case of organic milk.

In most of the cases considered, excluding the "lactose-free and functional group", convenience stores and supermarkets set the highest prices for each category of specialties. In general, both the A_{depth} and the average prices of specialty categories comply with the pricing policy and assortment planning strategies commonly used in the different formats of large-scale retailers (Solgaard and Hansen, 2003; Zielke, 2010). The purchasing channel is therefore a discriminating factor in the definition of the price of milk specialties (Stiletto, 2020). In addition, supermarkets and hypermarkets reveal a comparable depth of assortment for the two best-selling categories in the

specialty milk market (organic and lactose-free). Despite the differences in assortment depth between these two formats, the planning policies of these two product lines seem to be moving towards equalising the number of the type of items available. Indeed, in recent years, an increase in the volumes of specialty milks sold in supermarkets only has been observed (Rama, 2019).

The largest Partial η^2 (expressing the effect size of each variable) emerged in relation to the main effect of the organic variable (0.15), evidencing reasonable effect size and indicating that this variable explains 15% of variance in the definition of the average price. Finally, even when comparing the different brand categories, the average prices for each specialty varied significantly. In this case, the A_{depth} was very heterogeneous between the different brand groups (Table 8), highlighting how the specialties refer mainly to private labels (or brand of distributor), followed by the leading brands.

This result is in line with the definition of market leader and also with the choices made by distributors to increasingly differentiate the range of products available in the various stores. As reported in the recent Assolatte report (Assolatte, 2018) and in the research by Merlino *et al*. (2021), a large amount of milk present in LSR distribution is identifiable based on the distributor's brand. Private labels, on the other hand, allow retailers to increase the degree of product differentiation, while simultaneously building up the level of customer loyalty and the brand value of the product through unique identification with the point of sale.

Across the three main milk specialty categories, the highest average price was recorded in leading brands for organic and functional milk, while for "Other producers" the highest price was for lactose-free milk. In general, the distributor brands held the cheapest product items in all specialty categories (Bonanno and Lopez, 2005; Kumar, 2007).

By analysing the ANOVA table (Table 9), it can be seen that the main effect of the brand group is always significant, except in the case of lactose-free milk, for which it is the "brand group*lactose-free" interaction that has a significant influence on the product price setting.

This result confirms the importance of the brand, a key element for the company, as a discriminating factor in defining the selling price, above the type of product itself, and as an element of differentiation of a product (Sudari *et al*., 2019). In our research, each company seems to have a different price management strategy, highlighting the importance of this element for the consumer's evaluation of the product. The result is price inhomogeneity among product types influenced by the brand. Thus, in the case of the speciality milk, the brand reflects the high reputation of the producer/brand, the high level of customer loyalty, and the level of satisfaction. From this dynamic, it appears that product choice is almost exclusively dictated by brand choice (Mariska *et al*., 2019). At the same time, the combined effect of

Table 8 - Average price (€/l) recorded for each category of milk specialty comparing the brand categories

Brand Group*	Organic		Lactose-free		Functional		Organic and functional		Lactose-free and organic		Lactose-free, organic, functional		Lactose-free and functional	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
OP	1.569 (n=112)	0.724	1.719 (n=43)	0.514	1.527 (n=9)	0.401	2.525 (n=18)	1.489	/	/	/	/	/	/
DB	1.480 (n=83)	0.246	1.393 (n=35)	0.094	1.259 (n=32)	0.417	1.557 (n=9)	0.058	1.910 (n=50)	0.134	1.892 (n=16)	0.233	1.550 (n=1)	/
L	1.807 (n=62)	0.133	1.359 (n=174)	0.423	1.901 (n=211)	0.664	/	/	/	/	/	/	1.739 (n=58)	0.272
Total mean	1.610 (n=257)	0.514	1.425 (n=260)	0.432	1.806 (n=256)	0.666	2.110 (n=27)	1.173	1.910 (n=50)	0.134	1.892 (n=16)	0.233	1.736 (n=59)	0.271

* Brand groups: OP = other producers; DB = private labels; L = leader brands.

brand and lactose-free in the definition of the price suggests that, in the case of lactose-free products, consumer choice is also dictated by the nutritional characteristic of milk (lactose-free), in addition to the to the product brand. The health issue behind the choice to buy lactose-free milk defines a purchasing pattern especially based on the safeguarding of consumer health. Indeed, in the consumer's decision-making process for lactose-free milk, the prevention of gastric disturbances is the first choice motivation, for which the consumer would also be willing to pay a higher price (Rizzo *et al.*, 2020).

Considering the size effect, the Partial η^2 are low in all cases, except between organic and brand groups.

Conclusions

This research aimed to explore the characteristics of specialty milk supply in different formats of large-scale retail distribution, investigating aspects related to product sustainability (such as origin and packaging), assortment depth, proportion of branding, and pricing policies used for the various product categories. We adopted the same methodology used in our previous research pertaining to conventional cow milk allowing the characterization of the whole cow's milk supply, both of conventional and specialty products, available in the large-scale retailing distribution of the considered market.

Our key findings show that the supply of the specialty milk assortment is characterized by a wide range of organic and functional products to meet the demands of consumers who are increasingly attentive to sustainable and healthy milk. Furthermore, the massive presence of leading and OP branded products especially linked to the indication of national or local origin on the label, highlights how the indication of origin is an important differentiation and recognition factor used by speciality milks producers.

The specialty milk market is continuously growing and has major strengths compared to the conventional product, related to the high level of differentiation, product innovation and price competitiveness. In this sense, research demonstrates a high penetration rate of these products, which are offered on the market in different combinations, widely in different LSR formats and at a price higher than that of the commodity. In addition, we have seen how specialty milk producers encourage the implementation of product features according to consumer needs (from choice of packaging to indication of origin), creating clear growth opportunities for an increasingly competitive and expanding market.

This research highlights the strengths that characterise the specialty milk market; however, the limited geographical area investigated should be considered a limit of this research. Given the socio-demographic

heterogeneity and lifestyles of the Italian population, which certainly determine different food choices, it would be interesting to replicate the research in north-east, central and southern Italy and make a cross-area comparison of the characteristics of the special milks supply. Although this market segment represents an important source of income for producers, these results could provide ideas and concrete tools for growth and differentiation (e.g. indication of origin, differentiation of packaging) also for the conventional milk market which, even now, is continuing its negative trend mainly due to the constant decrease in consumption. Therefore, these results can be used by companies as a tool to evaluate the LRO in terms of milk specialties in order to increase company awareness and the added value of product differentiation strategies on the market.

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Functional food consumption by Portuguese university community: knowledge, barriers and motivators

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Abstract

This study aims to understand the attitudes, behaviors, and perceptions concerning the consumption of Functional Foods (FF) and to analyze the role of some socio-demographic factors. Cross-sectional study recruited a random stratified sample from universities. A web-based questionnaire was applied and data were analyzed using SPSS and FACTOR software. A large percentage of the respondents consumes FF regularly, mainly in intermediate meals, despite their poor knowledge about FF. Taste, price, convenience, lack of knowledge on how much to consume, and uncertainty on how to prepare FF are barriers to consumption. Consumers feel the need to eat it, believe in its safety, and have more confidence in the products than those who do not consume them. Benefits are not a motivator for the consumption. Bachelors and women are those that consume more FF in a daily/weekly basis; although age and scientific area did not have impact on the frequency consumption. The findings help food companies identify target market segments where introducing FF or increasing existing FF are most likely to succeed; as well as indicators for educational, public health and regulatory administrations.

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Introduction

Nowadays, food is not only seen from the perspective of satiating hunger or provide nutrients need by human metabolism, but also from the perspective of preventing diseases related to nutrition, and improving physical and mental health – so these features have gained prominence, and have become extremely important factors to consumers (Pappalardo & Lusk, 2016; Topolska *et al*., 2021).

Functional foods (FF) are a recent category of food products, marketed as having health benefits and have been considered as one of the areas of greatest potential growth in the food industry (Camacho *et al*., 2019). However, it should be noted that FF can only solve health problems if consumers are willing to buy them, which is the motivation for this study in the Portuguese context.

To date, many studies have investigated the factors that may predict people acceptance and consumption of FF, and a wide range of influential factors have been reported. However, studies conducted in different contexts pose challenges to gaining a clear and comprehensive understanding of the factors influencing consumer behaviour towards FF. The variety of factors and the complex relationships between them make it difficult to describe general trends, which would benefit scientists and functional food manufactures when developing and launching FF (Szwacka-Mokrzycka & Kociszewski, 2019). The wide range of influential factors also poses challenges for communicating and marketing professionals in the FF industry when developing accurate and precise communications strategies and other promotional materials designed to improve consumers acceptance of FF.

Thereby, in developed societies, the FF products market is dynamic, has boomed in recent years and it will continue to expand (Vicentini *et al*., 2016), thus reflecting the positive association made by consumers of these products to the adoption of healthy eating habits (Domínguez Díaz *et al*., 2020). Major producing FF brands are present in the Portuguese market, which may reveal the interest of consumers for this type of products; on the other hand, the topic of FF is relatively recent among Portuguese people, and there is a shortage of research in the area, such as encompassing consumer behavior and marketing. According to Chammas *et al*. (2019), gyms, schools and universities, and the internet could be useful communication and marketing routes to promote FF. In fact, public and private universities represent a population which include consumers with large range of socio-demographic characteristics (such us gender, age, educational level, scientific area, etc.).

The aim of this study was thus to investigate the attitudes, behaviors, and perceptions of the Portuguese university community towards this type of food. The development of these products is technically challenging, as well as

expensive; therefore, a better understanding of consumers' profile could be a key success factor for the market.

The paper is structured as follows. First, the approaches and findings of previous consumer studies on FF are explored. Thereafter, research hypotheses are developed; followed by the description of population, sampling procedure, data collection, and analysis. Finally, the results and discussion are presented with a focus on practical implications for marketing and advertising strategies in the consumption of FF, regarding the role of health public and governmental administration.

1. Background

1.1. *Concept and origin of functional foods*

Numerous definitions of "functional food products" have been proposed, but there is no official, universally accepted terminology standard of "functional foods" so far (Martirosyan & Miller, 2018). The concept was firstly introduced and developed in Japan and thereafter followed by the United States and Europe (Iwatani & Yamamoto, 2019). It was first promoted in the mid-1980s by Japanese scientists who studied the relationships between nutrition, sensory satisfaction, fortification, and modulation of physiological systems. In 1991, the Japanese Ministry of Health introduced rules for approval of a specific health-related food category called FOod for Specified Health Uses (FOSHU), which included the establishment of specific health claims for this type of food (Siró *et al*., 2008). European stakeholders only pay attention to its importance in the 1990's (Vicentini *et al*., 2016); FF were introduced in the European market via multinational food companies, such as Nestlé, Danone, Unilever, and Kellogg's.

An operative definition of functional products has been proposed in the European Union, within the FUnctional FOod Science in Europe (FUFOSE) project: an FF is a food product that makes a positive impact on one or more physiological functions of the organism, and besides its main nutritional properties improves the human health and is beneficial in decreasing the risk of diseases (Diplock *et al*., 1999). The FF products are consumed as a part of the normal diet rather than as capsules, pills, or other forms of food additives and can contain active biological compounds such as polyunsaturated free fatty acids, omega-3, fiber, carotenoids, vitamins, minerals, or probiotics (Camacho *et al*., 2019). Nutrient-rich ingredients like fruits, vegetables, nuts, seeds, and grains are often considered functional foods as well. Oats, for instance, contain a type of fiber called beta-glucan, which has been shown to reduce inflammation, enhance immune function, and improve heart health (Bashir & Choi, 2017). Similarly, fruits and vegetables are packed with antioxidants, which are beneficial compounds that help protect

against disease (Pem & Jeewon, 2015). According to Jung *et al.* (2018), the consumption of FF containing such active biological compounds as omega-3, fibers, probiotics, vitamins, and minerals would assist individuals to meet the recommended intakes of these essential nutrients and maintain overall health. It has also been demonstrated that FF with reduced sugar, fat, and sodium would have physiological benefits and/or reduce the risk of chronic disease, beyond basic nutritional functions (Lim *et al.*, 2016).

1.2. *Functional food market trends*

As mentioned above, the market has witnessed a growing awareness of consumers who, through consumption behaviors, influence manufacturers' decisions (Szwacka-Mokrzycka & Kociszewski, 2019). Betting on this, agro-food sector carries great risks because costly development of new products to the market does not guarantee they will be accepted by consumers (Vicentini *et al.*, 2016). Health and wellness has been one of the most important drivers of innovation in food and beverage markets. However, the development of new foods presents many marketing and technological challenges to product developers with high reported failure rates in functional foods (Bogue *et al.*, 2017). Reasons for failure in the functional foods market include: too many benefits from a single brand, benefits that are often not relevant to the consumer, relying on the selling power of the ingredient rather than the benefit, and using nonrelevant carriers (Mellentin, 2009). On the other hand, this is a very attractive sector for entrepreneurial investment, since consumers are willing to pay more for FF – which, in some cases, may reach an increase of 30-50% versus conventional product alternatives (Vecchio *et al.*, 2016). The trends driving growth in the functional food market include: consumers interested in the prevention of health issues, the increasing cost of healthcare, the steady increase in life expectancy, and the desire of the aging for improved quality of life in their later years (Bogue *et al.*, 2017). Recently, the sudden outbreak of COVID-19 amplified the need for eating healthy in order to boost human immunity – and this is providing a growth opportunity for the global health food market (Koncept Analytics, 2020).

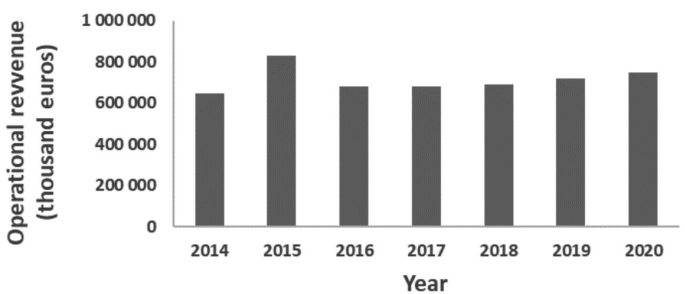
The global FF market was worth USD 187.5 billion in 2019 and is expected to reach USD 352.3 billion by 2027 – this is growing at an estimated annual average rate of 8.2% over the forecast period. The Asia Pacific region is expected to grow at the highest compound annual growth rate of 9.0% over that period. Moreover, the rising consumption of processed food in emerging countries, such as India and China, is likely to drive the demand for FF across the Asia Pacific region (Grand View Research, 2019).

In Europe, the acceptance of FF is much lower than that of USA, because people are more skeptical about the benefits of this type of product. On the other hand, there are differences in consumption between the inhabitants

of the various countries in Europe, and these foods are quite popular in Germany, UK, France, Russia and Italy. Germany is one of the leading markets for foods with health benefits – and also the country with the largest number of companies that market at least one FF in their portfolio (Kamble & Deshmukh, 2020). There is no data about FF market in Portugal.

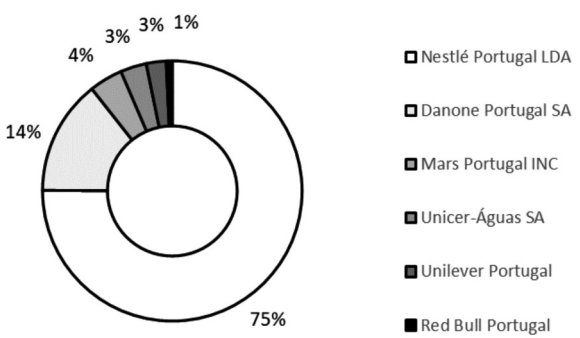
The key players in value chain of FF in the world are: Unilever, Sanitarium Health & Wellbeing Company, Royal Friesland Campina, Raisio Group, Standard Functional Foods Group Inc., Nestlé S.A., Murray Goulburn, Meiji Group, Glanbia Plc., Kraft Foods Inc. (Kamble & Deshmukh, 2020). Based on this information, we used the SABI database to compile information about the operating revenues of the most important FF companies in Portugal for the last 5 years (Figure 1).

Figure 1 - Evolution of operational revenues of the top six Portuguese companies that manufacture FF



In Figure 2, we can observe the company sharing (100% = 758.174 thousand euros) in 2020.

Figure 2 - Market share of the top six Portuguese companies that manufacture FF in 2020



1.3. *Consumption of functional foods*

The consumption of FF, which is the dependent variable in this study, is defined as the frequency of consumption and is measured on a 5-point semantic scale, ranging from 1 = never to 5 = every day.

We conceptualize that variations in the consumption of FF depend on four groups of factors: knowledge about FF concept, barriers, food choice motivators perceived and socio-demographic characteristics. It is thus hypothesized that all four groups of factors are significant determinants of functional food consumption. Each is discussed briefly in turn.

H1: *The knowledge about the concept of FF is associated with the consumption of FF.*

Consumers' knowledge has been identified as an important predictor of their functional food acceptance and consumption (Baker *et al*., 2022).

According to Sääksjärvi *et al*. (2009), the knowledge is crucial in this kind of product setting that is characterized by features that are more numerous and complex than those of food in general, and in which the benefits yielded by functional foods cannot be easily assessed.

Urala and Lähteenmäki (2007) argue that consumers are unlikely to pay extra for a functional food, compared to an equivalent "conventional" one unless there are clear and salient perceived benefits. Empirical evidence supports this – Labrecque *et al*. (2006) found that knowledge had a positive impact on acceptance of functional foods. Similarly, Carrillo *et al*. (2013) attribute low consumption of functional foods in Spain to a lack of knowledge. According to Ares and Gámbaro (2007), the consumption of FF is negatively influenced by the lack of consumer understanding of the term functional food.

Therefore, consumer awareness of FF concept could have a significant impact on consumers' perception and acceptance of these kind of products.

H2: *The perception about barriers is associated with the consumption of FF.*

Following Downes (2008), there are two types of barriers for a healthy lifestyle: personal (lack of motivation and lack of time) and environmental barriers (lack of social support and lack of resources). In relation to the barriers, Verbeke (2005) also reported that the loss of flavor in FF compared to foods classified as conventional is something that consumers are unlikely to accept. In fact, sensory attributes, such as taste, flavor and texture, remain

very important for consumers (Çakiroğlu & Uçar, 2018; Kolbina & Ulrikh, 2020).

Among the features of food products that are particularly important for consumers, packaging deserves special attention. So, trust in the information provided on the label constitutes a key element for its acceptance, since the claimed benefits of FF may not be directly experienced by consumers in the short-run (Sajdakowska *et al*., 2018). Therefore, although communication and information are unable to change the characteristics of the products, they can shape the attitudes of consumers – and influence their choices and behaviors (Guiné *et al*., 2020), thus making it possible for them to choose what and where to buy without requesting an opinion from third parties (Vicentini *et al*., 2016).

In addition, the price has high importance in influencing consumers' attitudes, behavior and preferences about FF (Zafar & Ping, 2020) and can also be considered a perceived barrier.

H3: *The perception about motivators is associated with the consumption of FF.*

One of the most frequently mentioned motivators is health (Topolska *et al*., 2021). Regarding high costs of curative medicine, disease prevention is crucial, and there is evidence that FF consumers understand the role of this kind of product in maintaining good health (Camacho *et al*., 2019). Added to this, in the studies of Rezai *et al*. (2014) and Urala & Lähteenmäki (2007), the perceived reward was also reported to be the best predictor of consumption of FF.

According to Çakiroğlu & Uçar (2018), the factors most influencing the purchasing decisions of consumers were that "functional foods are necessary" and "functional foods are a part of healthy diet".

Another important feature for functional products is to be "reliable". Social trust, processing method and cultural values may also affect consumer willingness to use FF (Siegrist *et al*., 2015).

Finally, safety is also an important issue for consumer purchase decisions of FF. Consumers who are convinced of the safety of FF are more willing to consume them (Rasanjalee & Samarasinghe, 2019).

H4: *The socio-demographic characteristics of consumers are associated with the consumption of FF.*

Previous studies identified that the consumption of functional foods varies across socio-demographic segments (Topolska *et al*., 2021; Zanchini *et al*.,

2022). Regarding age, consumer behavior can change over time, especially in the case of new products or new technologies. In addition, women appear to be more receptive to FF than men, who demonstrate a less critical and more traditional understanding of eating. People who are most familiar with the concept of FF are people with higher educational qualifications and so FF are perceived differently by consumers according to schooling level (Chammas *et al.*, 2019; Rojas-Rivas *et al.*, 2018). However, according to Huang *et al.* (2019), consumers with less education are the least reluctant to accept FF.

2. Materials and methods

2.1. *Research instrument*

A questionnaire was prepared consisting of 21 questions mostly taken from studies previously published in the English studies (Mundhe, 2015; Urala, 2005; Urala & Lähteenmäki, 2007), and later translated to Portuguese (Corso & Benassi, 2012; Oliveira & Cardoso, 2010). The first part included 11 questions about knowledge of the FF concept and consumer behavior regarding these products. Such questions had dichotomous answers, five-level Likert scale, and single and multiple choice.

Several aspects were evaluated by using a single-item likert scale, such as those concerning knowledge about FF, concept, food groups, biologically active compounds, and brands associated with FF. For those who did not know what a FF was, a definition was given at the beginning to proceed with answering. To validate the correct knowledge of respondents who claim to know the concept, three phrases were given to be classified as true or false – the FF are: i) foods that contain biologically active compounds, ii) promote health and prevent diseases, and iii) combined with a balanced diet and a healthy lifestyle (Diplock *et al.*, 1999; Jung *et al.*, 2018). The second part of the questionnaire contained socio-demographic questions. The questionnaire was approved by the Ethics Committee of Maiêutica/ISMAI (decision no. 3/20, April 28, 2019).

2.2. *Data collection and sample*

The data collection methodology consisted of applying a web-based survey, using the open-source survey software Limesurvey v. 2.57.1. Disclosure of the questionnaire was sent, via e-mail, to all Portuguese universities with a request to share it with their community. This sampling technique was chosen

based on two facts: (i) we work at university, so sharing information between universities is easier than through social networks, supermarkets or alike under anonymity; and (ii) we took advantage of social context attributes (such as group cohesiveness) because generation of real time responses via internet and the like is more likely to convey meaningful data (Gupta *et al*., 2020).

The questionnaire was available between April 28 and June 3, 2020. The answers obtained were exported from the LimeSurvey online software to Microsoft Office Excel software v. 2016.

A stratified random sampling procedure, according to the type of institution and the 9 scientific areas, was applied according to the population data reported by the Instituto National de Estatística / National Institute of Statistics (2018) – so a final sample of 467 was obtained (Table 1). Respondents who did not authorize participation in the study, and those presenting incomplete questionnaires were dropped.

Table 1 - Sample description (%, N=467)

Scientific area	**Type of institution**		**Sample**	**INE**
	Public	**Private**		
Agriculture, Forestry, Fisheries & Science Veterinary	2.8	0.0	2.8	2
Arts & Humanities	7.7	1.7	9.4	10
Social Sciences, Business, Journalism & Law	25.5	6.4	31.9	33
Natural Sciences & Mathematics & Statistics	5.6	1.5	7.1	7
Education	2.6	0.9	3.4	3
Engineering & Manufacturing Industries & Construction	17.3	3.0	20.3	21
Health & Social Protection	12.2	3.9	16.1	15
Services	1.4	1.3	5.4	5
Information & Communication Technologies	2.6	1.1	3.6	3
Sample	80.3	19.7	100	
INE - Portuguese National Institute of Statistics	81.8	18.2		

Source: Instituto Nacional de Estatística (2018).

2.3. *Statistical analysis*

All data were encoded and later processed by IBM SPSS v. 27.0 and FACTOR (Lorenzo-Seva & Ferrando, 2020) statistical software.

Data analyses included descriptive and inductive statistical analyses. In the univariate analysis, parametric tests were performed for the mean, such as the T-test for independent samples; and tests for proportion, such as the binomial test (Keller, 2017). In the bivariate analysis, the chi-squared test, the Mann-Whitney U test, and the Kruskal-Wallis test are used to verify the existence of an association between two variables. When considering the barriers, The 5-point Likert scale was converted into a binary variable with the following criterion: totally disagree and disagree were grouped into "Disagree", while totally agree and agree were grouped into "Agree"; the cases in which the response was neither disagree nor agree were dropped. The decision-making for all tests was of a significance level equal or lower then 5%. In the multivariate analysis, exploratory factor analysis was conducted, determining how well the items were grouped and how well they measured the same factor (Bryam, 2016). The configuration of analysis was: Parallel Analysis (PA), Robust Diagonally Weighted Least Squares (RDWLS), promin-type rotation, polychoric correlations, and 95% confidence intervals (Lorenzo-Seva & Ferrando, 2006). Finally, Cronbach's Alpha was calculated to control the reliability level for each dimension found.

3. Results

3.1. *Characterization of the sample*

Regarding the 467 respondents, 71.1% were female. From Table 2, it can be seen that students who were attending a degree, had an average age between 20.3 and 28.2 years, depending on the academic degree at stake (as expected); as for teachers, the academic degree most represented is a doctorate, with an average age of 51.2 years.

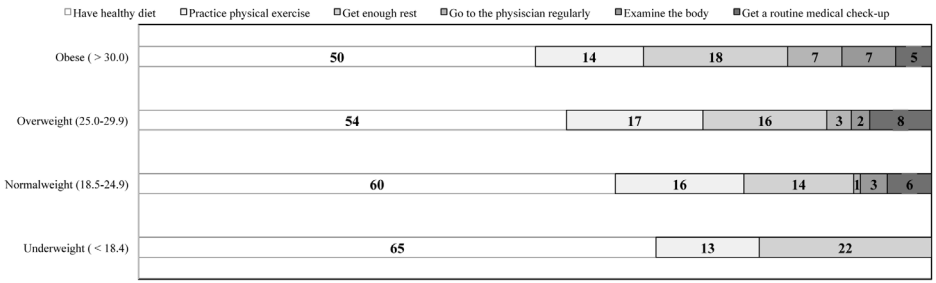
The researchers are MSc or Ph.D. holders, with an average age of 34.1 and 40.7 years, respectively. Finally, the largest percentage of other staff, either possessing BSc or MSc, ranged in age between 24 and 67 years. This wide range was expected, considering that includes from young technicians to the directors of university departments. In fact, it covers a wide range of consumers age and academic degree, as previously explained.

Table 2 - Respondents' age statistics (N=467)

Activity	Statistics	High school	Professional diploma	Bachelor	Master	Doctoral
Students	N		4	177	58	12
	min-MAX		18-25	18-56	18-56	23-50
	Median		19.0	21.0	21.0	26.0
	Mean		20.3	23.1	27.4	28.2
	Standard deviation		3.3	6.7	8.8	7.3
Teachers	N			13	22	58
	min-MAX			22-64	28-68	29-73
	Median			44.0	47.5	52.0
	Mean			45.2	47.9	51.2
	Standard deviation			12.1	8.7	8.4
Researchers	N				15	26
	min-MAX				23-56	28-57
	Median				31.0	38.5
	Mean				34.1	40.7
	Standard deviation				9.5	7.4
Other	N	13		36	22	11
	min-MAX	26-59		24-67	27-65	33-58
	Median	42.0		43.0	44.5	48
	Mean	43.3		43.7	43.9	45.9
	Standard deviation	10.6		9.1	9.4	8.1

Regardless of the value of Nutritious Status (based on Body Mass Index), the most important behavior's health maintenance of Portuguese university community was to keep a healthy diet (57.7%), followed by practice of physical exercise (16.1%) and ensuring enough rest (15.2%), as shown in Figure 3. Therefore, the attitude of respondents is aligned with the focus of study, which involves having a healthy diet.

Figure 3 - Attitude's health maintenance and Nutritious Status



3.2. *Attitudes regarding functional food consumption*

Our study found that 46.1% of respondents consume FF daily; however, those who consume FF daily and weekly add up to 80.0%. Another important result was to understand in which meals are the FF products preferentially consumed. The analysis was done on individual meals and in terms of meal combinations. Breakfast was the most frequently chosen meal by the Portuguese university community (78.0%). The afternoon snack was mentioned secondly by the respondents (64.1%), followed by the morning snack (39.2%). Additionally, the combination of breakfast and afternoon snack (16.2%), followed by breakfast, morning snack, and afternoon snack (12.8%) were the most chosen.

One also realizes that 73.2% (p=0.000) of respondents never or rarely confirm whether the FF has the desirable functional characteristics at the moment of consumption, with only 3.9% saying that it always does.

3.3. *Determinants of functional food consumption*

3.3.1. Knowledge about FF concept

In this study, knowledge about FF not only refers to its scientific concept but also how the consumer recognizes this type of food, biactive compounds, and brands.

Thirty-three percent of the respondents claimed to know the definition of FF at the beginning of the questionnaire. From those, 68.2% answered the three questions correctly, and 24.7% answered the second and third questions correctly – meaning that they do not have the scientific knowledge about FF, yet they know their benefits. In related studies, authors also presented a low prevalence of knowledge in Spain (23%), Italy (31%), Mauritius (32%), and

Lebanon (41%) (Chammas *et al*., 2019; González-Dias *et al*., 2020); although a high prevalence of knowledge of FF was reported in Sweden (84%) and USA (69%) (Kwon *et al*., 2020; Somehagen *et al*., 2013).

The most important FF products selected by respondents were, firstly and foremost – fruits and vegetables (47.5%; n=467), secondly – fish and fishery products (37.8%; n=222), and thirdly – oilseeds (27.4%; n=84) and whole cereals (25.0%; n=84).

It was also found that most respondents (more than 50%) recognize bioactive compounds. They identified fiber as the most suitable biological compound in FF (80.5%), and prebiotic/probiotics being the least suitable choice (56.3%) – between omega 3 and vitamins (74% and 73%, respectively) and antioxidants and calcium (67% and 63%, respectively). These results are similar to those obtained in several countries all over the world, such as Finland, Mexico, West Indies, and China (Badrie *et al*., 2007; Cong *et al*., 2019; Rojas-Rivas *et al*., 2018; Urala & Lähteenmäki, 2007).

The percentage of respondents who associated correctly Becel's brand to FF was statistically equal to those who did not (p=0.355). The 50% correct recognition of Becel's brand as FF might be explained by the fact that in a university context, there are not only young people who are concerned with health in general (Rodríguez-Tadeo *et al*., 2017), but also middle-aged people who are specifically concerned with cholesterol reduction (which is the benefit claimed by Becel for elderly people). Becel was the first brand advertised in Portugal as a food with health benefits; and so, it is a brand that cross generations. The three brands of the Danone Group present in the study were those that obtained the strongest identification as FF by the respondents: Activia (79.8%, p=0.000), Actimel (71.0%, p=0.000) and Danacol (64.0%, p=0.000); while Mimosa (34.0%, p=0.000) and Adagio (14.0%, p=0.000) did not. Vitalis (15%; p=0.000), Luso (17%; p=0.000), and Red Bull (3%, p=0.000) were not acknowledged as functional drinks by the respondents of this study. These results are very different from those reported for leading brands in the global market of functional drinks, also named energy drinks (Marketline, 2019).

An association between knowledge about the FF concept and consumption frequency was proven (p=0.000; see Table 3).

Table 3 - Consumption frequency (%) and knowledge of FF (Mann-Whitney U test, p=0.000)

Knowledge	**Consumption frequency**				
	Never	**Rarely**	**Monthly**	**Weekly**	**Daily**
No	0.2	2.4	1.7	8.4	20.3
Yes	2.6	14.3	7.5	17.1	25.5

As mentioned before, knowledge of respondents about FF is mainly focused on their beneficial health effects. Inspection of our results indicates that response to consumption by knowledgeable consumers is opposite, depending on whether they believe or not in their health-promoting features. It appears that those knowledgeable consumers that believe in FF health effects exhibit a higher frequency of consumption than their unknowledgeable counterparts – in monthly, weekly, or daily bases. Conversely, this effect is reversed in the case of non-regular consumers; those consumers that apparently do not believe on the healthy features of FF tend to consume even less thereof than their knowledgeable counterparts – in terms of a higher fraction of consumers that intake FF rarely or even none. Therefore, previous knowledge of FF enhances both positive and negative responses, whichever appropriate.

The hypothesis H1 is supported by our results: The knowledge about the concept of FF is associated with the consumption of FF.

3.3.2. Barriers perceived

Table 4 shows that associations between consumption frequency and barriers perceived by respondents exist at 5% of significance level.

The most important barriers for respondents that consume daily and weekly were price and availability of the product; followed by sensory characteristics, lack of knowledge how to prepare the food as well how much to consume.

Unlike previous studies, which show that consumers are willing to pay more for functional products that make health claims (Chammas *et al*., 2019; Vecchio *et al*., 2016), the respondents in this study considered that price was one of the major barriers for them to frequently consume FF.

We also verified that the loss of flavor in FF compared to foods classified as conventional is something that consumers are unlikely to accept; this fact was also reported by Verbeke (2005). Finally, new foods (such as FF) are not accepted due to a lack of knowledge about how much to consume and how to prepare FF.

The hypothesis H2 is supported by our results: The perception of the academic community about barriers is associated with the consumption of FF.

Table 4 - Barriers and consumption frequency (% respondents, Mann-Whitney U test)

Barrier		**Consumption frequency**					
		Never	**Rarely**	**Monthly**	**Weekly**	**Daily**	***p-value***
Taste/smell	Disagree	1.6	7.5	2.3	7.5	18.9	0.031
	Agree	1.3	8.8	5.9	18.6	27.7	
Aspect	Disagree	2.2	8.9	3.2	8.6	23.0	0.023
	Agree	1.0	6.7	5.4	17.6	23.3	
Price	Disagree	0.3	1.9	1.6	2.7	6.8	0.038
	Agree	2.5	16.4	8.2	19.9	39.4	
Availability/ convenience of the product	Disagree	1.8	5.7	1.4	5.4	14.3	0.020
	Agree	1.4	11.4	6.4	14.3	37.9	
Lack of knowledge about how much to consume	Disagree	1.0	5.9	2.6	7.5	18.0	0.024
	Agree	2.3	11.8	7.2	14.1	29.5	
Uncertainty of how to prepare the food	Disagree	1.3	6.1	1.7	7.7	19.9	0.013
	Agree	1.3	12.1	9.1	14.1	26.6	

3.3.3. Food choice motivators

In order to explore the motivators for consumption of FF, a group of items were grouped in factors. Because the cumulative explained variance obtained was 59.2%, the eigenvalue rule was applied (>1) – with a reduction of 18 items to 4 factors; although 5 items were accordingly excluded from the analysis, due to their low communalities (< 0.3). The adjustment of the model indexes was good: KMO = 0.80, RMSEA = 0.001, and CFI = 0.999 (Hair *et al*., 2018; Lorenzo-Seva & Ferrando, 2006).

The four factors found were named as Benefits, Safety, Confidence, and Necessity – as presented in Table 5.

The Cronbach's Alpha value for Confidence was less than 0.6 but, according to Cortina (1993), this is possible when there is an acceptable amount of association between items, but only small numbers of items involved.

Benefits explained 28.1% of the total variance followed by Confidence which explained 10.0% of the total variance. Finally, Necessity explained 8.2% of the total variance.

This study also showed, by using the Mann-Whitney U test, that the perception of Safety (p=0.001), Confidence (p=0.001) and Necessity

Table 5 - Factor analysis and description of scales

Factor	Item	Mean	St. Dev.	Loading	Cronbach's Alpha
Benefits	– Functional foods can have undesirable effects.	2.846	1.004	0.659	0.645
	– If used in excess, functional foods can be harmful to health.	3.253	1.148	0.751	
Safety	– The safety of functional foods has been very thoroughly studied.	3.137	0.842	0.520	0.599
	– Using functional foods is completely safe.	3.812	0.832	0.729	
Confidence	– Functional foods have better quality.	3.173	0.967	0.371	0.401
	– Functional foods cause the health benefits referred to in advertising.	2.816	0.878	0.546	
Necessity	– Functional foods are completely necessary.	1.865	1.003	0.788	0.709
	– For a healthy person it is worthless to use functional foods.	1.797	1.001	0.743	
	– Functional foods are a fad that will pass.	2.107	0.967	0.578	
	– Functional foods are a total sham.	1.876	0.976	0.682	

(p=0.000) are significantly higher for a regular consumer than non-consumers; regarding the Benefits (p=0.263), the importance is equal for both groups.

The hypothesis H3 is supported by our results: The perception of the academic community about motivators is associated with the consumption of FF.

3.4. *Socio-demographic characteristics*

Women tend to consume FF with a higher frequency than men. No association was found between frequency consumption and age index (Index Mundi, 2019) or the scientific area (see Table 6).

Table 6 - Socio-demographic characteristics and consumption frequency (% respondents, Mann-Whitney and Kruskal-Wallis association test)

	Socio-demographic characteristics	Consumption frequency					*p-value*
		Never	Rarely	Monthly	Weekly	Daily	
Sex	Female	1.1	9.4	7.3	20.3	33.0	0.033
	Male	0.7	7.3	1.9	5.1	12.4	
Age Index	Early working (15-24)	0.7	5.0	5.7	11.5	17.0	0.527
	Maximum working (25-54)	2.2	10.0	3.5	11.7	23.3	
	Mature working (55-64)	0.0	1.7	0.2	1.7	4.6	
	Seniors (65+)	0.0	0.2	0.0	0.2	0.6	
Scientific area	Agriculture, Forestry, Fisheries & Science Veterinary	0.2	0.2	0.4	0.9	1.1	0.368
	Arts & Humanities	0.2	1.5	0.4	2.8	4.5	
	Social Sciences, Business, Journalism & Law	0.6	4.5	4.1	8.4	14.3	
	Natural Sciences & Mathematics & Statistics	0.2	1.3	0.2	2.1	3.2	
	Education	0.0	0.9	0.4	0.9	1.3	
	Engineering & Manufacturing Industries & Construction	0.9	4.7	0.9	4.7	9.2	
	Health & Social Protection	0.2	1.5	2.1	3.2	9.0	
	Services	0.0	1.3	0.4	1.3	2.4	
	Information & Communication Technologies	0.4	0.9	0.2	1.3	0.9	
Academic degree	None	0.4	0.8	0.2	1.3	0.9	0.051
	Bachelor	0.6	7.5	6.0	12.8	21.4	
	Master	0.0	4.3	1.9	6.9	12.0	
	Ph.D.	1.7	4.1	1.1	4.5	11.6	

Irrespective of the frequency consumption, BSc holders are the most frequent consumers among all academic degrees, followed by Masters and Ph.D. holders. Similar findings were reported by other authors (Chammas *et al.*, 2019; Huang *et al.*, 2020; Rojas-Rivas *et al.*, 2018).

The hypothesis H4: The socio-demographic characteristics of the academic community are associated with the consumption of FF – is partially supported by our results.

4. Discussion

Functional food industry continues to experience new innovations and sales growth (Koncept Analytics, 2020), and the development of new functional foods and beverages remains a continued focus for international and national food companies (Zanchini *et al.*, 2022). As mentioned before, this study aims at understanding the determinants on consumption of FF such as the level of knowledge, barriers, motivators, and socio-demographic characteristics, regarding Portuguese market context. It differs from other studies because we used a representative sample of respondents from universities, which allow us to cover a wide range of consumers age, academic degree and specially scientific area of knowledge; additionally, it has the cohesiveness social impact mentioned as a positive effect for this type of study by Gupta *et al.* (2020).

We verified that healthy snacks and breakfast products must be considered as key growth of FF categories in food sector. Demand for whole cereals with fiber, probiotic dairy products, oilseeds, or simply fruit pieces are a reality for FF consumers due to the big difference in the choice of FF consumption, for intermediate meals, compared to the lunch and dinner. Even more than one meal per day is considered, the preferred combination continues to add intermediate meals, thus reinforcing the previous explanation.

The respondents revealed low level of knowledge concerning FF, and this fact was not associated to the scientific area of academic education in the university. Therefore, it can be explained by Portuguese economic development and the geographical position of Portugal, compared to the more developed countries.

First of all, the price of FF is too high compared to other categories of foods; and so, Portuguese's purchasing power is not enough to buy expensive food, in general – similar finding was obtained with students from the University of Alicante in Spain (González-Dias *et al.*, 2020). Therefore, even that there could be a niche market for FF, the right price must be fair according to the health claim when compared to the conventional ones. We then suggest two strategies: implement a discount to attract a wide range of consumers and gain trust of the client; or maintain the high prices but increase awareness about food added benefits and trust in brand. Secondly, we should consider the peripheral location of Portugal, and so a time gap may exist between the launch of FF in the strong markets (such as Germany) and in our country. Finally, consumers from north and central Europe countries have been considered more open-minded to consume FF than those from peripheral countries (Küster-Boluda & Vidal-Capilla, 2017). Probably, we can assume that Portuguese are less open-minded when related to FF; this is so, based on our results: (i) the sensory characteristics of FF (taste, texture,

aspect); and (ii) lack of knowledge about how much to consume FF and how to prepare FF were considered barriers to consumption. Considering that today is already possible to manufacture functional foods with the similar physicochemical characteristics, technological properties, and sensory acceptance than conventional foods (Pimentel *et al.*, 2021), these barriers can presumably associated with some fear of unknown foods, or risk perception associated with their consumption (Morawska *et al.*, 2016).

Therefore, we suggest short-term marketing strategies implying eating habits – such as promotional campaigns in schools and universities (distribution of free samples and introduction of FF in canteens), dissemination of FF concept and its benefits through internet and TV (for all ages); and advertisement that may include a more descriptive leaflet inside the food package, brochures or leaflets available at sales outlets, and further detailed information at the company's or brand's website for the middle-age and old people. Therefore, we believe that market demand for FF will presumably increase if educational strategies (to increase knowledge and to reduce barriers), marketing strategies (advertisment and labelling), and regulatory strategies (legal and clear information about the health claims) are implemented through a joint intervention between manufacture companies (marketers), information channels (internet, TV), schools, gyms and sport clubs, and government administration (such as education, public health, and regulation) – based on the facts that, by one side, consumers are increasingly concerned about their health and pay more attention to their lifestyle together with the healthiness of their diet; and that, by the other side, reducing noncommunicable diseases and the promotion of a healthy diet are on top of international and national policymakers' agenda (Topolska *et al.*, 2021). However, it would be very useful to accomplish all these actions, to have a specific definition of functional foods from the European Union in order to better specify the characteristics of these products and to delimit which foods can be included in this category (Zanchini *et al.*, 2022).

In particular, we also believe that marketers must pay more attention to the labels. This is based on the fact that a significant high percentage of respondents never or rarely confirm whether the FF has the desirable functional characteristics at the moment of consumption. One possible cause is the time spent in shopping is reduced, thus making consumers focus their attention mainly on the front package labelling (González-Dias *et al.*, 2020). The marketplace is filled with different package labels, but their true effects remain unclear; however, label changes perceptions and behaviors toward consumption (González-Dias *et al.*, 2020; Ikonen *et al.*, 2020). Reasons for failure of labelling in the FF market include too many benefits from a single brand, benefits that are often not relevant to the consumer, and relying on the selling power of the ingredient rather than the benefit (Bogue *et al.*, 2017).

Portugal has a strong tradition in the consumption of dairy products and a wide variety of dairy functional foods are provided on the supermarket shelves (Vicentini *et al.*, 2016). As mentioned before, label can change consumption behavior and as consequence it can benefit single brands. Additionally, FF tends to be dominated by heavily branded market leaders (Gray, 2002). This is the case we observed in our study with Danone group and previously reported for Turkey market (Gok & Ulu, 2019). A study on cultural differences in consumers' reactions to foreign-market brand extensions suggest that global marketing managers should be concerned with segmenting consumers based on country; within the country, differences in thinking styles may prove to be important in designing strategies for introducing vertical line extensions and managing potential spillover effects on parent brands (Allman *et al.*, 2019). Analytic thinker style, typically from Western markets, tends to focus on parent and extension features – and tries to reconcile them; this might be the reason for Danone group brand preferences.

On the other hand, knowing that Portugal is a larger producer of good quality of bottled natural water, national identity affects preference for brands with local vs. global consumer culture positioning (Bartikowski & Cleveland, 2017); this might be the reason for higher Portuguese functional drinks' recognition (16% Vitalis/Luso versus 3% Monster/Red Bull).

This study allowed to construct four motivators for FF consumption in Portugal. Benefits describes the perceived healthy and desirable effects brought about by FF consumption. People choose to consume products not only for their attributes alone, but also for the benefits they bring; they tend to prefer FF that primarily communicate disease-related health benefits and carriers that bear an image of healthiness (Kraus, 2015; Van Kleef *et al.*, 2005). This factor was also reported to be the best predictor of consumption of FF in other studies (Rezai *et al.*, 2014; Szakály *et al.*, 2019; Urala, 2005). Safety gives a sense of trust and ensures minimization of the loss of something valuable, namely health (Annunziata & Vecchio, 2011; Kraus, 2015). The safety of FF was found as one predictor of consumer's willingness to purchase FF in other studies (Mirosa & Mangan-Walker, 2018). Understanding health confidence as a value, and in particular giving health the status of the highest value that is worth being cared for, makes it the most important motivator for the purchase and consumption of FF. However, there is a general lack of confidence in the information provided on the product labels, thus suggesting that taste (Huang *et al.*, 2019) and benefits and price-quality ratio are the most important features in selecting FF. As discussed before, consumers' inability to distinguish misleading pricing strategies calls for regulators to ensure fair and ethical market practices, especially for healthy food (Samoggia, 2016).

In Portugal, based on a university context, the consumer profile of FF can be segmented by people with an academic degree with special attention to women; without differentiation regarding age and scientific area of knowledge. Consumers with more academic degree are also better able to understand the information on labels and relate a particular functional ingredient to its benefit (Bornkessel *et al.*, 2014). The fact that woman is the largest consumer of FF on a daily and weekly basis agrees with the results reported by several studies (Bogue *et al.*, 2017; Büyükkaragöz *et al.*, 2014; González-Dias *et al.*, 2020; Niva & Mäkelä, 2007; Siró *et al.*, 2008). Two studies mentioned that women provide strong arguments for their health concerns, while men are more dismissive of those health concerns and feel that they are more relevant to females (Bogue *et al.*, 2017; Kapoor & Munjal, 2017). Therefore, advertising should take these considerations into account and to appeal to the male market segment.

5. Conclusions

The level of knowledge on FF by Portuguese university communities was low; and the most recognized foods were unprocessed ones, and dairy products with probiotics or bioactive elements aimed at reducing cholesterol in the case of processed foods – with little association to the concept of functional food. Portuguese people preferably eat FF at breakfast, or as mid-morning and/or mid-afternoon snacks. The taste, price, lack of knowledge of how to prepare them, and how much to consume are barriers to consumption. Confidence, safety and need create positive attitudes towards consumption; while health benefits by themselves do not.

The profile of respondents that frequently consume FF are preferentially female holding a BSc. degree (no matter the scientific areas). One also found that consumers associate better international brands than national ones and this is probably caused by marketing strategies based on differences in thinking styles, concerning with consumer based on country and within country.

While the main aim of the industry is to sell its products, it could be counter-productive for companies in the FF sector to resort to advertising content that creates mistrust or confusion in the consumer. These conclusions should help domestic and multinational food companies in Portugal to design market strategy based on the identification of the determinants for consumption of FF. Companies should have a corporate social responsibility to use marketing through persuasive communication (advertising and correct labelling) as strategy to induce attitude change, which in turn would lead to a change in their intention and consumption behavior. A message to

Portuguese people must be sent: FF are completely safe, efficient in the prevention of diseases, and needed to keep a healthy diet in a clear and easily-understood way (assured by regulatory administration); as well as encourage consumers to read packaging/labelling information. To increase the knowledge and concerns about FF, the education and public health government administrations can give support to reach the valuable mass and bring about the required cultural change – and thus avoid functional food failure in terms of demand.

6. Limitations and future research direction

The use of a questionnaire implies the risk of wrong and incomplete answers, compared to another data collection instruments, such as focus group and interviews (Xhakollari & Canavari, 2019; Costa & Strehlau, 2020; Cong *et al*., 2020). Unfortunately, due to COVID-19 government restrictions, the use of such alternative methods was impractical. It would be also better to monitor consumer awareness of FF trends over time rather than using a cross-sectional survey. Finally, the interpretation of the results should be made with caution due to the sample characteristics (stratification of Portuguese consumers from universities according to scientific area and type of institution, all over the continent and islands).

Building on this study, for future research we propose a comparative study conducted in both developing and developed regions on cultural and economic differences related to functional food. To develop the FF market, it is necessary to understand how consumers evaluate the health benefit information on labels and to consider the differences between specific FF types (e.g., fruit yogurt or probiotic yogurt). Finally, it is important to conduct an economic analysis of FF to identify reasonable price premiums over corresponding conventional products, and based on differences between specific health benefit claims.

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Sustainable transition and food democracy: The role of decision making process in Solidarity Purchasing Groups

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Abstract

This study investigates how the decision making process in Solidarity Purchasing Groups (SPGs), intended as hybrid organizations, supports the sustainability transition in food systems. The process of sustainability transition in food systems involves many kinds of tensions, especially in the process of pursuing a multiplicity of economic, social and environmental objectives. This study focuses on the SPGs in Italy and study how they organize their internal decision-making process and their search for the group objectives. This paper argues that the decentralization of the decision rights in SPGs sustains the integration of such different objectives and coordinates efficiently the multifaceted values of their members. The empirical analysis shows that the decision rights are decentralized and that the decentralized decision rights positions in solidarity purchasing groups are associated with the pursuing of different objectives. Our findings indicate that SPGs contributes to the transitions toward sustainability in food systems by using organizational democracy mechanisms to coordinate tensions among social, market and environmental values.

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Introduction

Transitions toward sustainability entail profound modifications of both entrepreneurs and citizens worldviews (Hedstad *et al.*, 2020) and system structure (Bui *et al.*, 2019; El Bilali, 2020). The search for enhancing food system sustainability raises challenges in the institutional framework of economic and social relationships and in management strategies and practices (Eakin *et al.*, 2017; Ericksen, 2008). Inherently, the transition raises tensions of different nature among territorial and productive systems and within the organizations (Oskam *et al.*, 2021; Wannags & Gold, 2020). Tensions derive primarily from competing paradigms (Bui *et al.*, 2019; Gaitán-Cremaschi *et al.*, 2019) necessary to transition and from the coexistence of different institutional logics, i.e., different systems of taken-for-granted beliefs and practices that guide actors' behavior (Battilana *et al.*, 2018). Different institutional logics originate different, conflicting objectives concerning social, environment and economic fields, i.e., profit and no-profit objectives. The capability to solve the resulting tensions and to balance these multiple nature objectives are key conditions to guide a sustainable transition of organizations.

This paper concentrates on Solidarity Purchasing Groups (SPGs), a type of Alternative Food Network (AFN, Renting *et al.*, 2003) whose goals are to provide food to group members, but also to contribute to environment and health protections, to ethic goals and to implement democracy and social justice values (Anderson, 2008; Dedeurwaerdere *et al.*, 2017; Martino *et al.*, 2016; Prost, 2019; Giuca and De Leo, 2019). Recent studies have showed that AFNs tend to effectively combine economic and environmental objectives (Martino *et al.*, 2016; Torquati *et al.*, 2021). In particular, SPGs face the necessity to combine and balance the multiple objectives they aim to pursue, coping with tensions while maintaining the group coherence and stability and effectively contribute to food sustainability. This study explores which organizational mechanisms are implemented by SPGs to coordinate multiple and potentially conflicting objectives.

This study adds to the studies on the transition of food system toward sustainability in three ways. First, it shows that the decentralization of the decision rights among SPGs members integrate the group objectives in feasible patterns. Second, it submits that beyond the rooting of participation processes in society (Hassanein, 2003; Moragues-Faus & Morgan, 2015; Moragues-Faus, 2020; Prost, 2019), it is necessary to design and to adopt specific organizational aspects to support the development of food democracy. Third, this study advances in the analysis of the SPG governance, in particular with respect to the configuration of the decision making process, thereby adding to the recent literature (Dedeurwaerdere *et al.*, 2017; Duncan & Pascucci, 2017; Forssel & Lankoski, 2015, 2017; Manganelli *et al.*, 2020).

1. Conceptual framework

1.1. *Multiple objectives in SPG*

The multiplicity of objectives and their diverse nature are inherent to SPGs (Renting *et al*., 2012), given the heterogeneity of values and needs supporting the participation in AFNs are heterogeneous (Mount, 2012). Holloway *et al*. (2007) underlined the attention that AFNs pay to environmental impact of conventional food network, as well as ethical commitment on the technologies used in food production processes. AFNs seek to promote the adoption of technology oriented toward environmental and social sustainability (Dedeurwaerder *et al*., 2017). Focusing on trust food chain sustainability, Ilbery and Maye (2005) identified the coexistence of multiple values and related objectives spanning from producing healthy food and fair-trading to protection of animal welfare and social inclusivity. Sonnino and Marsden (2006) clarified that the focus on environmental, nutritional and health concern in AFNs can be understood as a term of complementarity with conventional food sector while embeddedness appears to be a more distinctive feature of AFNs values.

Fourat *et al*. (2020) examined the multiple aspects of values interaction in network practices to show the impact of food health and quality on equality issues. Mert-Cakal and Miele (2020) documented and conceptualized, in community supported agriculture, the way in which participation aligns technology and sustainability. The diversity of the value also originates a literature on hybrid food value chain intended as a chain in which operates both alternative and conventional actors (Klein & Michas, 2014; Le Velly & Dufeu, 2016). Fonte (2013) documented the diversity of values in SPGs and related them to both ideology and contexts and to the practices aimed at potentially transforming the local food system. Practices stemming from different values substantiate food democracy processes characterized by multiplicity of objectives in food production and consumption (Lang, 2005; Lang & Heasman, 2004; Renting *et al*., 2012), even though not systematically (Moragues-Faus, 2017).

The diversity of objective raises tensions which may undermine both the group stability and its capability to support sustainable transition. There is then the necessity of solving and managing tensions by organizational mechanisms. The diversity of objectives raises tensions on the allocation of the resources directly (e.g., knowledge, labour, storage houses) or indirectly (e.g., agricultural land) managed by the SPG. Pursuing different objective may actually entail conflicting resources uses. Operationally, a *resource use objective is intended as the goal to which a given resource productive use is aimed: the goal may regard the quantity and the quality – or both*

– *of the product, but it may also concern with the creation of positive externalities and the reduction of the negative externalities* (Martino *et al*., 2016). Unsolved tensions impeding effective resources uses compromises the possibilities of reaching the group objectives. The different nature of these objectives – economic, social, environmental – exacerbates the tensions as it tends to obstacle the integration of the institutional logics at stake. This study argues that the decentralization of the decision rights acts as a SPG organizational mechanism to solve tensions caused by this diversity of the institutional logics. To make cleat this point it is necessary underline the hybrid organizational nature of the SPGs.

1.2. *Hybrid organizing and integration*

The problem on how SPGs coordinate their members and farmers to guarantee a satisfactory achievement of the various objectives requires to solve internal tensions from distinct institutional logics. To this purpose, agents must design, negotiate and implement specific organizations and must allocate decision rights, promoting participation and facilitating on going management (Battilana *et al*., 2018).

Governance analysis of food networks has taken into account the territorial level (Brunori & Rossi, 2000), the extent of the supply chains (DuPuis & Block, 2008) or knowledge creation processes (Dupuis & Gillon, 2009). Duncan and Pascucci (2017) introduced systematic factors to explain the organizational forms chosen in AFNs. Martino *et al.* (2016) focused on the role of organizational practices determining the SPGs objectives in terms of resources uses. Forssell and Lankoski (2015, 2017) pointed out the role of power relationships and risk sharing in food networks. Manganelli *et al.* (2020) and Manganelli and Mouleart (2018) identified critical aspects in SPGs governance in terms scale, resources access processes and institutional frameworks. This approach observes SPGs though a hybrid governance form formed by four governance principles: hierarchy, anarchy, '*heterarchy*', solidarity (Manganelli and Mouleart, 2018, for details). Organizational, resources and institutional tensions are identified from these premises. The resulting model generalizes the understanding of the AFNs governance principles in a reflexive governance perspective (see Feindt and Weiland, 2018).

Our study contributes to this literature by adopting the concept of integration and by assessing the role decision rights configuration in SPGs governance. We assume that participation in the decision making processes facilitates the pursuit of multiple objectives (Battilana *et al*., 2018: 17). Both.

Integration is here held as the process of balancing, accommodating and reconciling diverse values to achieve and make decision making within an

organization effective (Battilana *et al*., 2018: 8). Hybrid organizing then is held to support the integration of different objectives. More precisely, *hybrid organizing are the activities, structures, processes and meanings by which organizations make sense of and combine aspects of multiple organizational forms and institutional logics* (Battilana & Lee, 2014; Battilana *et al*., 2018). This study assumes that SPGs adopt hybrid organizing to combine multiple and potentially conflicting objectives.

The SPG includes several participants who are assigned to given positions with specific decision rights (e.g. group member, coordinator, assembly of the members, product manager) (Martino *et al*., 2016). A *decision configuration* can be then defined as *the set of the positions entitled to decide and the types of decisions they could take* (*who decides what*). According to Battilana and Lee (2014) and Battilana *et al.* (2018), the possibility of integrating different objectives, as requested by the transition toward sustainability, is conditioned by the decentralization of decision rights over the uses of the resources. Actually the sharing of decision rights is central to coordinate distinct resources uses (Grandori, 2017a), while decision rights held the legitimate entitlement to participate in and exert influence on an organization's ongoing management (Battilana *et al*., 2018: 4).

The conceptual framework of this study shows how coherent SPG organization is expected to be able to integrate objectives of different nature. Therefore, this study aims at testing two hypotheses:

Hypothesis 1: *the decision making process in an SPG is decentralized.*

Hypothesis 2: *decentralized decision rights are associated to specific resources uses objectives.*

These hypotheses were tested by an empirical analysis.

2. Method of the empirical analysis

2.1. *Sample and variables*

The governance of the Italian SPGs is basically based on the objective of developing members participation (Barbera *et al*., 2020; Novelli and Corsi, 2018; Fonte, 2013). To do so, the governance address the different motivations essentially directed toward responsible consumer values, especially to mobilize members and families over environmental and social issues (Graziano and Forno, 2012, p. 122). The multiplicity of objectives is then necessarily a theme to be considered in the group governance

analysis. In carrying out empirical analysis, this complexity requires to design methodological approaches able to capture multiple aspects of the phenomenon. In this study, we adopted a mixed-method approach was used to collect data of SPGs in Italy. It was namely adopted a "development strategy" (Greene *et al*., 1989), departing with three cases study (reported in Martino and Pampanini, 2012) to delineate the basic feature of the decision making processes and to inform and help to establish the basis for the collection of quantitative data.

The research took the form of an internet survey. An online questionnaire was submitted to 900 Italian SPGs contacted through the effective e-mail addresses that were available through the Italian SPGs network ReteGas. (www.retegas.org). The survey yielding the database used here was conducted in 2013. More recently, several scholars have shown the vital role of democracy in SPG (Manganelli and Mouleart, 2018, 2002; Prost, 2019; Dedeuwardere *et al*., 2019; Forno and Graziano, 2015), highlighting aspects which were captured by the survey. In order to contribute to this literature, our study provides a conceptual framework focusing on the organizational mechanisms behind the democratic governance of SPGs. Moreover, this promotion of participation seems to have played a critical role in tackling the effects of Covid-19 pandemic on food access (Forno and Graziano, 2020).

The questionnaire included the following categories of questions: i) the general characteristics of each SPG (i.e., year of foundation, number of members, etc.); ii) the SPG's decision-makers (i.e. members and their positions); iii) an evaluation of the group objectives.

We considered the following members and positions:

- *Management*: a person who is on the board of the group, but is not present in every group; the main role is to channel the group activities toward common goals.
- *Group member*: a person who is just a basic participant, but she/he is normally active in several areas in the informal structure of the group.
- *Product Manager*: this person is in charge of operational activities, such as gathering the information required to organize food purchases and deliveries. She/he is normally a key figure. The Product Manager organizes food product provision by preparing and delivering the purchase order to the producers: he/she organizes the distribution of the product among the members.
- *Assembly*: the meeting of all the members of the group varies in the number of activities of debate and decision-making, which depends on the history of the specific group.
- *SPG Network*: a network of all the SPGs; it is established throughout the country. Although the groups do not necessarily have to comply with

the suggestions of the network, the latter can contribute to the strategic perspective of the groups, and help their interaction with policy authorities on several levels.
- *President/Coordinator*: she/he is the person responsible for the group and is sometimes formally elected by the assembly. The President plays two main roles: he/she represents the group in certain official relationships (normally with local public authorities) and helps coordinate group activities.

We also considered two general types of decisions: strategic decisions, referring to the group structure and a long-term activity, and operational decisions, regarding the daily functioning of the group.

Strategic decisions
- *Management of relations*: this is concerned with the management of group agreements with external bodies, such as local or national policy authorities, other SPGs, or the SPG network.
- *Member Entry/Exit*: this regards the acceptance of a new member and the potential exit of an existing member.
- *Group activity*: this is generally a specification of the fields of *the* group activities (e.g. food, culture, etc.).
- *Selection of producers*: producers are selected according to the group's expectations regarding health, the environment and ethics.

Operational decisions
- *Product basket*: the product usually procured by the group is specified periodically. The relevant decision depends on other purchases and on producer selection, the product plan and logistics.
- *Product Planning:* this decision concerns the possibility of a group co-producing the food with farmers;
- *Purchase orders*: just a simple decision required to procure food;
- *Logistics*: this refers to all the possible decisions that have to be made to guarantee distribution of the product purchased.

According to the members' values and expectations, the SPG identifies specific resource use objectives (R_s). Three sets of resource use objectives are considered:

Health
- To select farmers able to supply safe foods (*SAFETY*).
- To define the production process (*DIRECTING*).
- To select food with "no residuals" (*NORESID*).

- To select food with "no preserving additives" (*NOPRESERV*).
- To select foods for babies (*BABYFOOD*).

Environment
- To select the farmers on a geographical basis (*PRODZONE*).
- To choose locally grown food grown (*CLOSEZONE*).
- To choose food with reduced environmental impact (*ENVIMP*).
- To enhance the transportation logistics (*ENHLOG*).
- To select products from traditional genotypes (*TRADGEN*).

Convenience, ethical, symbolic and hedonic attributes
- To choose low price food (*LOWPRICE*).
- To choose foods produced according to ethical guidelines (*SOCRESP*).
- To choose unique foods (*ELABFOOD*).
- To choose continuously available food (*AVAILAB*).
- To choose traditional foods (*TRADIT*).

The respondents were then required to assign a score to each objective by answering to the following question: *How do you evaluate the following objectives in the context of the strategy of your group?* using a 7-point Likert scale (from j=-3: *Not important* to j=3: *Very important*). The respondents were expected to be able to express the average evaluation of the group's resource use objectives because of their positions held.

2.2. *Testing approach*

Having classified the SPG decision-makers and the decisions usually made by each decision-maker in SGP (see below), the empirical analysis presents a test of Hypothesis 1 by simply investigating the frequency distribution of the decision types across the decision-makers positions.

To test the hypothesis 2, elaborating on the approach of Ethiraj and Levinthal (2009), this study assumes that the impact (β_i) of the decision (d_{is}, with i=1,…,I) made by each decision-maker D_k (with k=1,…,K) is associated to the value of the resources use objectives (μ_s, with s=1,…,S):

$$\mu_s = f(d_{is}, \beta_i) \quad (1)$$

A generalized ordinal logistic model (Williams, 2010) was estimated for each decision-makers and type of decision to test the Hypothesis 2. The dependent variables of each model is the value of a given resource

use objective and the independent variables are the decisions made at each decision-making position. This approach is appropriate for the types of variables used in the study and also for the correction of potential heteroskedasticity. The model estimated is:

$$g(\mu) = \beta_0 + \beta_1 d_{1k,s} + \ldots + \beta_1 d_{i,k,s} \quad (2)$$

where g function is a link function and $\beta_{i,\,k,\,s}$ are the parameters to be estimated (for *i.th* decision, made by the *k.th* decision maker for the *s.th* resource use). More precisely, the coefficient $\beta_{i,\,k,\,s}$ estimated in a generalized ordinal logistic model indicates the impact of each independent variable on the dependent variable in a log-odd scale. Let μ be score assigned by the respondent, with j=1,…,7 categories. Then $P(\mu \leq j)$ is the cumulative probability of μ less than or equal to a specific category j=1,…,J−1. For each μ_s the log odds of being unlikely highly scored (versus low scoring) when the decision maker D_k take the decision $d_{i,k,s}$ is $\beta_{i,k,s}$ times higher ($\beta_{i,k,s}$ positive)/lower ($\beta_{i,k,s}$ negative) than in the case the decision was not taken. The estimated parameters make possible to capture the connection that the decision-makers expect to establish between the decision and objective. If a parameter $\beta_{i,k,s}$ estimated is not statistically significant, there is not an effect of the decisions d_{ik} on the resources uses objective value. The opposite is true if a parameter $\beta_{i,k,s}$ estimated is statistically significant: in this occurrence, the decisions d_{ik} has an effect on the resources uses objective value.

To test the hypothesis 2 it is necessary to verify if the parameters estimated whether or not the decisions are associated to the resources use objective value. The empirical analysis allows one to reject the hypothesis of association between the decision and the resources uses objective value (none statistically significant parameter) or alternatively indicate a probable effect of the decentralization of the decision rights with the objectives. We test hypothesis 2 adopting the following criteria:

a) *the larger the number of statistically significant parameters for each model (type of decision and positions), the more effective is the decision on that resources allocation to multiple objectives*;
b) *the larger the number of effective decisions for each position, the more decentralization is likely to be effective to resources allocation on multiple objectives and then the more the integration is likely to be effective.*

3. Results

Our accidental sample consists of 121 valid questionnaires returned back by respondents available to participate in the research. We collected information from members in different positions. The group President or

coordinator represents 64% of our respondents. Product managers and simple members constitute 11% of our observations each, i.e., 22% altogether. The remaining 14% is represented by founder members. In addition to food provision, 34.4% of the groups provide clothing, 68.8% are engaged in cultural activities, and 29.6% conduct other activities including solidarity activities and swap parties.

First, we investigate the distribution of the decisions separated into strategic or operational types, and into decision-makers/members with different positions. According to the democratic nature of the SPG, we expected to find that: a) each decision-maker has a role in both strategic and operational types of decisions; b) there is an association between the types of decisions and the types of decision makers, thereby indicating a democratic participation and decentralized structure of decision rights across different members in the decision-making process.

Considering the aforementioned 6 types of decision makers and 9 type of decisions, we required to each respondent to specify "*who decides what*". The answers from these questions form the basis of the interconnection between the members' positions and their participation in the decision-making process for strategic and operational decisions, i.e., they highlight the existence or not of a decentralized structure of decision rights among the positions. Table 1 summarizes the results.

The marginal distribution indicates that the different members of the group almost always address all types of decisions, including strategic ones. It shows that the *Group Member* participates in the largest number of decisions (37.0%), whereas the *SPG Network* appears in the smallest number (6.7%). The *Assembly* plays an important role (21.6%), whereas the *President*, *Management* and *Product Manager* positions have an average participation (13.1%, 11.0%, 10.6%, respectively).

These findings provide support for Hypothesis 1 by highlighting the fact that members with different positions participate in all decisions of the SPG. Even simple group members also take part in the decision-making process regarding strategic decisions, which denotes the decentralization of decision rights among the various decision-makers of the group and the democratic nature of this arrangement. Accordingly, the extent of the involvement of *Group members* and the *Assembly* indicates the fact that the groups rely on a democratic and collectively determined approach (Duncan & Pascucci, 2017; Graziano & Forno, 2012; Renting *et al*., 2012).

Moreover, we test the internal consistency of the decision by a simple χ^2 test to be conducted on the sample distribution of the decision made by types and decision-makers. The chi-square test $\chi^2 = 390.00$ (0.00) it indicates there is an association between the type of decisions and the positions of the categories are involved in different parts of the decision-making process, as expected from Hypothesis 1.

Table 1 - Contribution of each decision maker to each type of decision. The table show the relative frequencies of each type of decision (column) made by each type of decision maker (rows). The classification in strategic and operational decisions is useful to distinguish the scope of the resources with respect to the ability of engage the economic resources and the time span of the activities related

	Type of decision									
	Strategic decisions				**Operational decisions**					
Decision Maker	**Management of relations**	**Entry/Exit members**	**Activity of the group**	**Selection of producers**	**Product basket**	**Planning of Product**	**Planning of purchasing**	**Purchasing orders**	**Logistic**	***Total***
SPG Network	2.2	0.2	0.6	0.9	0.5	0.1	0.9	0.5	0.9	*6.7*
President/Coordinator	2.6	2.1	1.5	1.3	1.0	0.6	1.6	1.1	1.3	*13.1*
Management	1.0	1.5	1.4	1.5	1.4	0.6	1.5	0.8	1.2	*11.0*
Group Member	4.2	4.7	4.2	3.5	3.8	5.1	3.9	4.0	3.6	*37.0*
Product Manager	0.7	0.3	0.5	1.7	0.9	0.5	2.6	3.4	0.0	*10.6*
Assembly	2.1	2.1	3.7	3.3	3.7	1.1	2.9	1.0	1.5	*21.6*
Total	12.8	10.9	11.8	12.1	*11.4*	*8.0*	*13.4*	*10.9*	*8.5*	*100.0*

Source: The authors.

Tables A.1-9 in the Annex presents the OGLM estimates.

The models show that many combinations of decision rights allocated to SPG decision-makers are significant statistically for the different types of objectives of the SPG.

For each of the nine types of decision, a set of six models (one for each type of positions) was estimated, and repeated for each of the 15 resource uses objective. Therefore, each of these models indicate the impact of the allocation of decision rights – to a specific type of position (e.g., *Management*) for a specific decision (e.g., *Management of relations*) on a given objective (e.g., *Ethics*: in this case, the impact is positive, statistically significant, and equal to 1.29). The impacts of *Planning of purchase*, *Purchasing order* and *Logistic* are present only for certain positions and objectives. A more obvious difference is evident for the remaining types of decisions, especially for the conventional market objectives. Specifically, the larger the number of significant parameters, the higher their distribution among decisions, positions and objectives, and the stronger the support for accepting *Hypothesis* 2. A small number of models present an overall statistical significance (models with small probability of model χ^2). In addition, note that some models do not present ancillary parameters (symbol *cut_j*) because the corresponding scores are absent in the sample. The findings of the study illustrate the positive and negative expected associations by types of decisions and SPG member's position summarized in the Table 2.

There is no specific pattern in the association between resources uses and decision configuration, since statistically significant associations are distributed among all uses and positions, regardless their nature. This suggests that decentralization of rights is a key mechanism when combining resources uses objectives. This in turn highlights the role of hybrid organizing when handling the tensions from different institutional logics and integrating different objectives (Battilana *et al.*, 2018).

4. Discussion

The empirical evidence shows that the decision rights in SPGs are decentralized and that decentralization influence the positive scoring of potentially conflicting group objectives. The decentralization of the decision rights makes it possible to coordinate interest in alternative resource use objectives, in accordance with a cohesive governance based on sharing rights. This evidence delineates a key feature of the governance of the Italian SPGs in the perspective of members participation (Barbera *et al.,* 2019; Novelli and Corsi, 2018; Fonte, 2013. Graziano and Forno, 2012). Motivations- behind the decentralization put it in use as an integration mechanism: different drivers make the decentralization an integration mechanism.

Table 2 - Syntesis of the OGLM results

Positive relationships		Negative relationships	
Strategic decisions	**Operational decisions**	**Strategic decisions**	**Operational decisions**
Management of relations (Table A.1): *Assembly* decision right is (positively) associated with the resource uses implemented by the farmers/producers (*Directing and Nopreserv*) in the *Health* subset. *Network* decision rights also appears as being positively related to *Directing*.	**Product basket** (Table A.5): *Product Manager decision right* is associated is associated with the resource uses related the kind of food (*Babyfood*) in the *Health* subset.	**Management of relations** (Table A.1): *Group member* decision right is (negatively) associated with the resource uses implemented by the farmers/producers to produce traditional foods (*Tradit*) in the *Conventional* subset.	**Product basket** (Table A.5): *Product Manager decision right* is associated with the resource uses implemented by the farmers/producers to choose food with reduced environmental impact (*Envimp*) and to enhance the transportation logistics (*Enhlog*). *Assembly* decision right is associated with resource uses to not choose unique foods (*Elabfood*) and traditional foods (*Tradit*) in the *Conventional* subset.
Member Entry/Exit (Table A.2): *Management* decision right is associated with the resource uses in terms of being able to supply safe foods (*Safety*) - *Health* subset. *Network* decision right is associated with the resource uses related the kind of food (*Babyfood*) in the *Health* subset and the resource uses to choose continuously available food (*Availab*) and traditional foods (*Tradit*) in the *Conventional* subset.	**Product Planning** (Table A.6): *Product Manager* decision right is associated with the resource uses to choose continuously available food (*Availab*) in the *Conventional* subset.	**Member Entry/Exit** (Table A.3): *Product Manager* decision right is associated with the resource uses to not select farmers able to supply safe foods (*Safety*), and to not to select food with “no residuals” (*Noresid*) in the *Health* subset.	**Product Planning** (Table A.6): In the Environmental subset, there is a negative association between *Group member* decision right, the selection of products from traditional genotypes (*Tradgen*) and the choice of traditional foods (*Tradit*). *Assembly* decision right is negatively associated with the resource uses related to the kind of food (*Babyfood*) in the Health subset. This type of position is also associated with resource

Table 2 - continued

Positive relationships		Negative relationships	
Strategic decisions	**Operational decisions**	**Strategic decisions**	**Operational decisions**
			uses to choose continuously available food (*Availab*) and to choose unique foods (*Elabfood*) and traditional foods (*Tradit*) in the *Conventional* subset.
Group activity (Table A.3): *Management decision right* is associated with the resource uses implemented by the farmers/producers to choose food with reduced environmental impact (*Envimp*) in the *Environment* subset. *Group member* decision right is associated with the resource uses implemented by the farmers/producers (*Directing*) in the *Health* subset.	**Purchasing planning** (Table A.7): *Product manager* decision right is associated just with *Availab*.	**Group activity** (Table A.3): *Product Manager* is (negatively) associated with the resource uses implemented by the farmers/producers (*Nopreserv*) in the *Health* subset. *Group member* decision right presents a negative association related to the choice of traditional foods (*Tradit*). *Assembly* decision right is (negatively) associated with resource uses to choose unique foods (*Elabfood*) and traditional foods (*Tradit*) in the *Conventional* subset.	**Logistics** (Table A.9): *Assembly* decision right is (negatively) associated with the with the resource uses implemented by the farmers/producers regarding the kind of food (*Babyfood*) in the *Health* subset. This position (*Assembly*) is also associated with resource uses to choose continuously available food (*Availab*) in the *Conventional* subset. *Group member* decision right is (negatively) associated with resource uses to not choose unique foods (*Elabfood*) and traditional foods (*Tradit*) in the *Conventional* subset.
Selection of producers (Table A.4): *Product Manager decision* right is associated with the resource uses related the kind of food (*Babyfood*) in the *Health* subset and the resource uses to choose continuously	**Purchasing orders** (Table A.8): *Network* decision right is associated with the resource uses to select the farmers on a geographical basis (*ProdZone*) in the Environmental subset.	**Selection of producers** (Table A.4): Both the *Assembly* and *Network member* decision rights are (negatively) associated with the resource uses to choose continuously available food (*Availab*) in the Conventional	

Table 2 - continued

Positive relationships		Negative relationships	
Strategic decisions	**Operational decisions**	**Strategic decisions**	**Operational decisions**
available food (*Availab*) in the *Conventional* subset.		subset. In addition, Assembly decision right is also negatively associated in resources uses to choose unique foods (*Elabfood*) and traditional foods (*Tradit*) in the *Conventional* subset. *President* decision rights also present a negative association with the production of traditional foods.	
	Logistics (Table A.9): *Network* decision right is associated with the definition of production processes (*Directing*).		

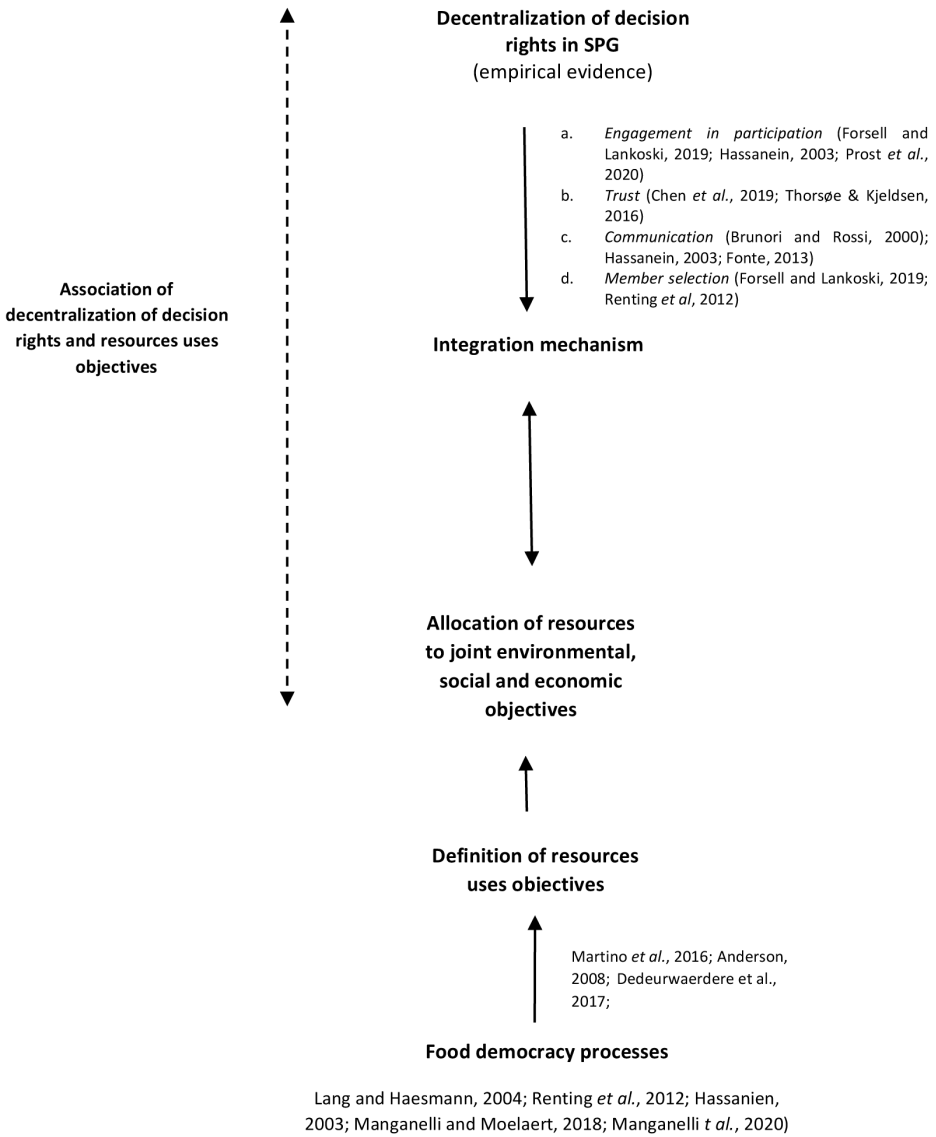
Source: The authors.

Engagement and the expectations in participations animating these groups (Forsell & Lankoski, 2015; Hassanein, 2003; Moragues-Faus, 2017; Prost, 2019) is the first driver. The evidence proposed shows that the decision rights allocation varies with positions and type of decisions. However, data do not allow to corroborate or to confute the idea that decentralization is associated to effective egalitarian engagement in decision making (Moragues-Faus, 2017). Trust is a further driver allowing the group to decentralize the decision rights without consuming resources in excess in negotiating and this, in turn, contributes to foster trust (Chen *et al*., 2019). Trust is also developed by routinized process (Thorsøe & Kjeldsen, 2016), which can in turn sustain the process of decentralization. Moreover, participation and communication processes in SPGs (Brunori & Rossi, 2000; Fonte, 2013; Hassanein, 2003) favour processes of negotiating to integrate institutional logics by specific mechanisms (Battilana *et al*., 2018). An inherent driver to decentralize the decision rights is SPGs' process of members selection (Forsell & Lankoski, 2015; Renting *et al*., 2012), which corresponds to the organizational democracy processes identified by Battilana *et al*. (2018). These drivers converge in the distribution of the decision power, facilitating the negotiation processes necessary to decentralize the decision rights.

With respect to the framework elaborated by Manganelli and Mouleart (2018), this study shows that the decentralization of the decision rights intervenes in solving the tensions among different resources uses objectives and by combining them in the SPG decisions making process. Manganelli and Mouelart (2018) and Manganelli *et al*. (2020) extensively argue that both institutional and governance tensions arise in SPGs due to the coexistence of different organizational forms and potentially conflicting approaches. Even in the organizational perspective of this study, hybrid governance is invoked as another possibility to solve these tensions. However, as underlined by Figure 1, the focus here is to examine the organizational dimensions of the governance. Resources are actually used at the micro-level, where organizations live and interact and relevant innovations emerge to re-connect people and food (De Schutter 2017).

Our findings suggest that SPG outcomes depend upon specific organizational mechanisms. Based on literature, the Figure 1 illustrates the relationship between decentralization of the decision rights and multiple resources uses objectives pursued by SPGs. Figure 1 introduces a distinction between the role of the decision rights decentralization and resources uses objectives and food democracy processes. This study expands on the results of Duncan and Pascucci (2017) by comparing democratic forms and emphasizing collective decision-making as a distinctive feature in food networks. In addition, this study highlights the division of labor of the decision making process, which characterizes the democratic organization

Figure 1 - Interpretation of the empirical results: decision rights decentralization integrating resources use objectives



(Battilana *et al.*, 2018; Grandori, 2017a, 2017b). The multiplicity of the SPG's objectives and their distinct economic nature combine the group expectations in an integrated and collective/collaborative perspective. This decentralization allows the group to allocate resources in a more efficiently

way and strengthens the network structure by reducing the possibilities of opportunistic behaviors related to concentrated decision power arising from an organizational culture of democracy (Battilana & Lee, 2014; Battilana *et al.*, 2018). This indicates SPGs as both a support to the sustainability transition of food systems and a hybrid organization managing sustainability tensions delineating examples of organizational schemes also for sustainable transitions (Govindan *et al.*, 2020; van Bommel, 2018).

Moreover, our findings highlight the importance of decentralization of decision rights to form the democratic participation in SPGs. Although the democratic nature of an organization entails deeper engagement of the participating members (Grandori, 2017a, 2017b), the decentralization of the decision rights remains a key feature (Battilana, 2018). Notably, the evidence gathered also indicates that decentralization does not have unidirectional linkages with values entailed by the resources uses objectives. We found no discriminatory links between positions and health, environmental, and conventional goals. Our results point to a complex combination of multiple but intertwined objectives in SPGs.

Conclusions

This research highlights the importance of organizational mechanisms of SPGs in coordinating multiple objectives in a way that helps overcome tensions among members' institutional logics and achieve broader systemic goals, such as sustainability transition in food systems.

This study also highlights how decision rights are distributed among stakeholders in the SPGs and how they are connected to the group objectives. It was shown an association between a decentralized configuration of decision rights and resource use objectives. This empirical association reflects the balancing among different objectives in the SPG as a hybrid organization containing organizational democracy mechanisms. As yet unexplored in literature, it provides evidence of the interconnection between resource use, complex social values and democracy as a governance structure in the context of sustainable food provision.

The results indicate that the adoption of this kind of decision rights decentralization can be another solution for other types of AFNs, which are susceptible to coordination problems (Carzedda *et al.*, 2018; Forssell and Lankoski, 2018). This study presents empirical evidence that SPGs are surrounded by a democratic organizational set-up, aligning decision rights and resource use objectives. Nevertheless, we acknowledge a limitation of our study due to the date of data collection. Further studies dealing with similar phenomena are highly welcomed.

This study leaves room to explore other interesting points. The implementation of resource use and mobilization in detail should be explored with the different SPG decision-makers. However, an exploration of this part could reveal additional evidence on the efficiency of resource use and the effectiveness of the configuration of a democratic decision. Second, we did not explore the different levels of democracy between the groups. An analysis of whether one group is more or less democratic and whether it pays closer attention to certain specific objectives is also worthy of study. Third, we left room to investigate how the complex, organizational form of a SPG affects the coordination of an agri-food value chain. A comparison of situations in which this arrangement is or is not present could raise points of relevance to the modern systems of coordination and distribution of food. Finally, the connection and conflicts between macro- and micro-level of food democracy could also be a promising field in the sustainability literature.

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Annex

*Table A.1 - Relation management - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

	HEALTH					ENVIRONMENT					CONVENTIONAL				
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
RELMAN_Man	0.605	0.633	0.684	-0.417	0.146	-0.203	-0.155	0.554	-0.478	0.105	0.106	1.293	0.0425	-0.0556	-0.424
	(0.87)	(1.38)	(1.10)	(-0.89)	(0.34)	(-0.36)	(-0.30)	(1.03)	(-1.12)	(0.24)	(0.22)	(1.68)	(0.10)	(-0.14)	(-0.91)
RELMAN_Group	-0.0124	0.622	0.221	-0.313	-0.571	-0.326	-0.510	0.444	0.376	0.393	-0.407	-0.113	-0.486	-0.308	-0.844*
	(-0.02)	(1.53)	(0.40)	(-0.79)	(-1.52)	(-0.78)	(-1.10)	(0.83)	(0.84)	(0.98)	(-1.22)	(-0.23)	(-1.45)	(-0.81)	(-2.13)
RELMAN_Pman	0.227	0.430	0.281	0.487	0.527	0.526	0.198	0.770	0.150	0.306	0.0535	0.611	0.0280	0.445	0.316
	(0.30)	(0.90)	(0.37)	(0.74)	(0.71)	(1.20)	(0.39)	(1.19)	(0.23)	(0.60)	(0.10)	(0.91)	(0.05)	(0.70)	(0.53)
RELMAN_Assem	0.631	0.799*	0.197	0.767*	-0.569	0.614	0.0762	0.508	0.581	0.400	-0.110	0.173	-0.448	-0.227	-0.343
	(1.10)	(2.31)	(0.42)	(2.07)	(-1.66)	(1.71)	(0.21)	(1.14)	(1.51)	(1.18)	(-0.30)	(0.36)	(-1.29)	(-0.66)	(-1.02)
RELMAN_Net	-0.216	0.692*	0.114	0.0993	0.350	0.392	0.0193	-0.305	-0.178	-0.187	-0.417	0.515	-0.153	0.361	0.187
	(-0.45)	(2.07)	(0.24)	(0.26)	(1.04)	(0.97)	(0.05)	(-0.73)	(-0.46)	(-0.56)	(-1.14)	(1.02)	(-0.44)	(1.04)	(0.46)
RELMAN_Pres	-0.406	0.332	0.189	0.335	-0.331	-0.0336	-0.0487	0.131	0.167	-0.403	-0.0810	0.248	0.114	0.0853	-0.478
	(-0.90)	(1.00)	(0.44)	(0.90)	(-1.03)	(-0.10)	(-0.14)	(0.32)	(0.47)	(-1.17)	(-0.24)	(0.52)	(0.33)	(0.26)	(-1.43)
cu1	-4.830***	-2.505***	-4.438***	-4.532***	-3.525***	-3.849***	-3.844***	-4.456***	-4.626***	-4.087***	-4.471***	-4.315***	-3.293***	-2.149***	-1.332***
	(-3.88)	(-4.42)	(-3.78)	(-4.07)	(-6.36)	(-4.86)	(-6.35)	(-3.88)	(-4.09)	(-5.06)	(-5.58)	(-3.71)	(-7.24)	(-5.42)	(-3.73)
cu2	-4.126***	-1.305**	-3.022***	-3.829***	-2.586***	-3.433***	-2.816***	-3.755***	-3.512***	-2.946***	-2.789***	-3.611***	-2.430***	-0.984**	-0.253
	(-4.50)	(-3.14)	(-4.56)	(-4.72)	(-6.08)	(-4.98)	(-6.06)	(-4.48)	(-5.24)	(-5.30)	(-6.14)	(-4.23)	(-6.64)	(-2.81)	(-0.78)
cut3	-3.182***	-0.634	-2.048***	-2.388***	-1.931***	-2.398***	-1.660***	-3.045***	-2.794***	-2.511***	-2.122***	-2.469***	-2.110***	-0.438	0.382
	(-4.81)	(-1.72)	(-4.07)	(-5.17)	(-5.33)	(-4.63)	(-4.70)	(-4.72)	(-5.60)	(-5.37)	(-5.52)	(-4.16)	(-5.97)	(-1.24)	(-1.18)
cut4	-1.358**	0.524	-0.933*	-1.408***	-0.414	-1.071**	0.324	-2.455***	-2.048***	-1.428***	-0.754*	-0.63	-1.404***	0.702	1.256***
	(-2.66)	-(1.54)	(-2.21)	(-3.75)	(-1.32)	(-2.61)	-(1.02)	(-4.81)	(-4.72)	(-3.64)	(-2.36)	(-1.44)	(-4.00)	-(1.82)	-(3.71)
cut5		1.613***		0.174	0.688*	0.864*		-0.572	0.222	-0.309	0.51		-0.0191	1.711***	2.144***
		-(4.32)		-(0.54)	-(2.04)	-(2.15)		(-1.50)	-(0.63)	(-0.87)	-(1.63)		(-0.06)	-(3.76)	-(5.23)
cut6		3.301***			2.337***					1.259***	2.388***		1.601***	4.491***	3.491***
		-(6.83)			-(5.08)					-(3.45)	-(5.35)		-(4.16)	-(4.13)	-(5.84)
$\chi2$ (df_m)	4.471(6)	20.23(6)	2.349(6)	6.867(6)	10.47(6)	5.346(6)	1.680(6)	4.441(6)	4.980(6)	3.794(6)	3.698(6)	5.427(6)	5.258(6)	3.819(6)	6.459 (6)
Prob ($\chi2$)	0.613	0.00252	0.885	0.333	0.106	0.500	0.947	0.617	0.546	0.705	0.717	0.490	0.511	0.701	0.374
Pseudo R^2	0.0261	0.0377	0.0102	0.0232	0.0202	0.0165	0.00677	0.0224	0.0185	0.0118	0.00789	0.0371	0.00897	0.00763	0.0203
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.2 - Member entry/exit - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

	HEALTH					ENVIRONMENT					CONVENTIONAL				
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
ENTRY_Man	2.100**	0.436	0.429	-0.0108	0.163	0.175	0.0289	0.405	-0.275	0.273	0.144	0.897	-0.196	0.380	0.255
	(2.78)	(1.03)	(0.79)	(-0.03)	(0.42)	(0.45)	(0.07)	(0.91)	(-0.69)	(0.72)	(0.39)	(1.45)	(-0.51)	(1.02)	(0.57)
ENTRY_Group	1.494	0.372	0.0605	0.165	-0.0658	-0.532	-0.712	0.181	0.327	-0.256	0.396	-0.0811	-0.297	0.246	-0.533
	(1.83)	(0.68)	(0.11)	(0.33)	(-0.14)	(-1.14)	(-1.65)	(0.33)	(0.76)	(-0.65)	(0.78)	(-0.14)	(-0.82)	(0.45)	(-1.37)
ENTRY_Pman	-2.078**	0.0264	-1.958**	-1.032	0.780	-0.681	-0.760	-0.812	-0.860	0.285	-0.537	-0.217	0.502	1.006	0.251
	(-2.81)	(0.05)	(-2.93)	(-1.31)	(1.27)	(-1.33)	(-1.25)	(-1.24)	(-1.23)	(0.60)	(-0.89)	(-0.20)	(0.91)	(1.90)	(0.46)
ENTRY_Assem	-0.106	-0.371	-0.319	0.00144	-0.232	-0.0113	0.276	0.122	-0.0500	0.282	-0.345	0.796	-0.640	-0.610	-0.312
	(-0.22)	(-1.05)	(-0.71)	(0.00)	(-0.67)	(-0.03)	(0.74)	(0.30)	(-0.14)	(0.80)	(-0.99)	(1.65)	(-1.58)	(-1.58)	(-0.90)
ENTRY_Net	0.203	0.839	-0.599	0.537	1.195*	0.0468	-0.0430	-1.753	-0.863	0.0419	0.413	-0.162	0.154	1.366*	0.946*
	(0.18)	(0.84)	(-0.96)	(0.78)	(1.97)	(0.05)	(-0.05)	(-1.85)	(-1.72)	(0.09)	(0.48)	(-0.10)	(0.19)	(2.42)	(2.58)
ENTRY_Pres	-0.452	0.0287	-0.875	-0.506	-0.262	0.102	-0.190	-0.652	0.285	-0.158	-0.594	0.0788	-0.359	0.0463	-0.605
	(-0.87)	(0.08)	(-1.84)	(-1.36)	(-0.75)	(0.28)	(-0.52)	(-1.54)	(0.78)	(-0.45)	(-1.65)	(0.16)	(-1.01)	(0.14)	(-1.63)
	-		-											-	-
cut1	4.874***	-3.337***	5.536***	-5.059***	-3.245***	-4.197***	-3.895***	-5.194***	-4.889***	-4.008***	-4.446***	-4.433***	-2.346***	1.360***	3.293***
	(-4.02)	(-6.14)	(-4.56)	(-4.57)	(-6.38)	(-5.72)	(-6.02)	(-4.35)	(-4.41)	(-5.12)	(-5.53)	(-3.98)	(-5.39)	(-4.82)	(-7.24)
	-		-												-
cut2	4.171***	-2.163***	4.128***	-4.359***	-2.300***	-3.783***	-2.867***	-4.496***	-3.765***	-2.870***	-2.763***	-3.727***	-1.138***	-0.241	2.430***
	(-4.48)	(-5.69)	(-5.46)	(-5.27)	(-6.79)	(-6.06)	(-6.34)	(-4.67)	(-5.58)	(-5.81)	(-7.26)	(-4.78)	(-3.55)	(-0.95)	(-6.64)
	-		-												-
cut3	3.188***	-1.523***	3.138***	-2.909***	-1.649***	-2.757***	-1.717***	-3.789***	-3.038***	-2.436***	-2.095***	-2.587***	-0.555	0.422	2.110***
	(-5.09)	(-4.40)	(-5.19)	(-6.98)	(-5.59)	(-6.61)	(-5.39)	(-4.84)	(-5.60)	(-5.72)	(-6.25)	(-5.33)	(-1.80)	-(1.67)	(-5.97)
			-												-
cut4	-1.190**	-0.452	1.929***	-1.923***	-0.165	-1.447***	0.296	-3.165***	-2.290***	-1.359***	-0.701*	-0.756	0.609	1.332***	1.404***
	(-2.89)	(-1.56)	(-4.66)	(-5.63)	(-0.63)	(-4.37)	-(1.10)	(-5.53)	(-5.08)	(-3.67)	(-2.52)	(-1.91)	-(1.91)	-(4.79)	(-4.00)
cut5		0.544*		-0.366	0.907**	0.472		-1.179**	-0.0304	-0.251	0.595*		1.610***	2.232***	-0.0191
		-(1.97)		(-1.23)	-(3.22)	-(1.59)		(-3.14)	(-0.09)	(-0.78)	-(2.05)		-(4.16)	-(6.12)	(-0.06)
cut6		2.160***			2.523***					1.293***	2.483***		4.388***	3.573***	1.601***
$\chi 2$ (df_m)	16.10(6)	3.413(6)	10.87(6)	4.764(6)	5.441(6)	4.103(6)	4.382(6)	6.464(6)	5.579(6)	2.250(6)	6.137(6)	7.030(6)	7.811(6)	10.47(6)	9.730(6)
Prob ($\chi 2$)	0.0132	0.755	0.0923	0.574	0.489	0.663	0.625	0.373	0.472	0.895	0.408	0.318	0.252	0.106	0.137
Pseudo R^2	0.110	0.00841	0.0561	0.0141	0.0110	0.0101	0.0144	0.0375	0.0155	0.00552	0.0144	0.0351	0.0165	0.0200	0.0178
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.3 - Group activity - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

			HEALTH					ENVIRONMENT					CONVENTIONAL			
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
ACTIV_Man	0.474	0.613	0.689	0.182	0.0846	0.273	0.379	1.282*	0.0137	0.123	0.383	0.931	0.236	0.512	0.583
	(0.79)	(1.49)	(1.10)	(0.46)	(0.23)	(0.63)	(0.97)	(2.32)	(0.04)	(0.32)	(0.99)	(1.67)	(0.67)	(1.25)	(1.37)
ACTIV_Group	-0.239	0.808*	0.141	-0.0664	-0.364	-0.000666	-0.714	-0.158	-0.110	-0.520	-0.381	-0.322	-0.0930	-0.135	-0.942*
	(-0.45)	(2.12)	(0.24)	(-0.15)	(-1.00)	(-0.00)	(-1.65)	(-0.32)	(-0.26)	(-1.46)	(-0.96)	(-0.70)	(-0.25)	(-0.33)	(-2.37)
ACTIV_Pman	-0.884	0.659	-0.574	-1.840*	1.034	0.0899	-1.000	-0.697	-0.231	0.590	-0.320	0.998	-0.0503	0.00961	-0.258
	(-1.10)	(0.94)	(-0.88)	(-2.26)	(1.75)	(0.17)	(-1.46)	(-1.21)	(-0.33)	(0.86)	(-0.44)	(0.96)	(-0.06)	(0.01)	(-0.43)
ACTIV_Assem	0.479	-0.0688	-0.114	-0.0182	-0.315	0.259	-0.461	0.0981	0.183	-0.0399	-0.0644	-0.0477	-0.851*	-0.514	-0.780*
	(1.02)	(-0.21)	(-0.24)	(-0.05)	(-0.87)	(0.66)	(-1.28)	(0.22)	(0.51)	(-0.12)	(-0.20)	(-0.10)	(-2.40)	(-1.48)	(-2.23)
ACTIV_Net	1.188	-0.397	-0.203	-0.676	0.514	0.435	0.0550	-0.523	0.305	0.269	-0.312	0.534	0.00601	0.667	0.208
	(1.08)	(-0.67)	(-0.26)	(-1.07)	(0.94)	(0.59)	(0.07)	(-0.81)	(0.62)	(0.69)	(-0.45)	(0.62)	(0.01)	(1.00)	(0.33)
ACTIV_Pres	0.795	0.513	-0.236	0.488	-0.730	0.349	0.322	0.0834	0.589	-0.0255	-0.309	0.509	-0.417	0.226	-0.722
	(1.44)	(1.41)	(-0.50)	(1.08)	(-1.86)	(0.83)	(0.82)	(0.18)	(1.38)	(-0.06)	(-0.80)	(0.99)	(-1.12)	(0.59)	(-1.87)
	-		-											-	-
cut1	4.381***	-3.010***	4.874***	-5.082***	-3.596***	-3.751***	-4.192***	-4.704***	-4.583***	-4.193***	-4.346***	-4.566***	-2.524***	1.513***	3.652***
	(-3.76)	(-5.15)	(-3.96)	(-4.15)	(-5.86)	(-4.77)	(-6.10)	(-3.99)	(-4.08)	(-5.02)	(-5.52)	(-3.85)	(-5.17)	(-4.57)	(-7.03)
	-		-												-
cut2	3.678***	-1.816***	3.465***	-4.379***	-2.654***	-3.336***	-3.151***	-4.002***	-3.462***	-3.062***	-2.656***	-3.863***	-1.325**	-0.442	2.794***
	(-4.08)	(-4.61)	(-4.57)	(-4.75)	(-5.32)	(-5.13)	(-6.95)	(-4.57)	(-5.15)	(-5.69)	(-6.70)	(-4.26)	(-3.17)	(-1.37)	(-6.09)
	-		-												-
cut3	2.714***	-1.143**	2.497***	-2.869***	-2.000***	-2.316***	-1.976***	-3.292***	-2.739***	-2.630***	-1.984***	-2.725***	-0.751	0.191	2.479***
	(-4.73)	(-3.10)	(-4.37)	(-5.63)	(-4.52)	(-5.46)	(-5.02)	(-4.57)	(-5.36)	(-5.67)	(-5.95)	(-4.62)	(-1.90)	-(0.59)	(-5.60)
															-
cut4	-0.853*	-0.0455	-1.373**	-1.818***	-0.471	-1.013**	0.0763	-2.702***	-1.994***	-1.551***	-0.609*	-0.895*	0.425	1.078**	1.729***
	(-2.10)	(-0.14)	(-3.01)	(-4.58)	(-1.35)	(-2.65)	-(0.21)	(-4.53)	(-5.14)	(-3.81)	(-2.06)	(-2.11)	(-1.10)	-(3.10)	(-4.43)
cut5		0.951**		-0.199	0.648	0.899*		-0.802	0.239	-0.422	0.650*		1.436**	1.983***	-0.259
		-(2.87)		(-0.58)	-(1.94)	-(2.38)		(-1.95)	-(0.72)	(-1.22)	-(2.20)		-(3.25)	-(5.34)	-(0.75)
cut6		2.620***			2.304***					1.147***	2.524***		4.214***	3.357***	1.406***
		-(6.32)			-(5.70)					-(3.37)	-(5.82)		-(4.00)	-(5.36)	-(3.78)
$\chi 2$ (df_m)	6.893(6)	7.496(6)	2.014(6)	8.889(6)	9.460(6)	2.220(6)	7.868(6)	8.746(6)	2.794(6)	4.564(6)	4.183(6)	7.599(6)	7.370(6)	5.104(6)	15.80(6)
Prob ($\chi 2$)	0.331	0.277	0.918	0.180	0.149	0.898	0.248	0.188	0.834	0.601	0.652	0.269	0.288	0.531	0.0148
Pseudo R^2	0.0423	0.0221	0.0132	0.0333	0.0224	0.00778	0.0266	0.0362	0.0109	0.00900	0.00968	0.0332	0.0180	0.0127	0.0414
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.4 - Selection of producers - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

	HEALTH					ENVIRONMENT					CONVENTIONAL				
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
SELECT_Man	0.904	0.328	0.904	0.301	0.677	0.0573	0.158	0.796	-0.299	0.115	0.501	0.591	-0.124	0.381	0.474
	(1.58)	(0.87)	(1.59)	(0.77)	(1.59)	(0.14)	(0.40)	(1.66)	(-0.74)	(0.29)	(1.36)	(1.02)	(-0.31)	(0.90)	(1.1)
SELECT_Group	0.349	-0.164	0.231	0.203	-0.0317	0.0596	0.185	-0.467	-0.519	-0.482	-0.0205	0.108	-0.395	0.110	-0.447
	(0.73)	(-0.48)	(0.49)	(0.54)	(-0.09)	(0.17)	(0.50)	(-1.09)	(-1.32)	(-1.43)	(-0.06)	(0.25)	(-1.06)	(0.30)	(-1.34)
SELECT_Pman	0.149	0.210	0.837	0.440	0.909*	0.558	-0.0517	0.113	-0.638	0.144	0.0932	0.298	-0.0767	1.065**	0.293
	(0.30)	(0.54)	(1.54)	(1.02)	(2.29)	(1.40)	(-0.13)	(0.25)	(-1.63)	(0.42)	(0.23)	(0.61)	(-0.22)	(2.87)	(0.85)
SELECT_Assem	0.459	-0.264	0.215	-0.181	-0.506	0.0618	-0.419	0.271	-0.389	-0.113	-0.270	0.0656	-0.719*	-0.754*	-0.920**
	(0.96)	(-0.77)	(0.45)	(-0.50)	(-1.33)	(0.17)	(-1.24)	(0.63)	(-1.10)	(-0.34)	(-0.82)	(0.15)	(-2.14)	(-2.28)	(-2.62)
SELECT_Net	-0.138	0.0535	-0.322	-0.377	-0.526	-0.157	0.00559	-0.637	-0.336	0.169	-0.845	0.815	0.148	-0.907*	-0.386
	(-0.24)	(0.12)	(-0.46)	(-0.68)	(-1.19)	(-0.31)	(0.01)	(-1.11)	(-0.73)	(0.38)	(-1.85)	(0.92)	(0.35)	(-2.05)	(-0.68)
SELECT_Pres	0.258	0.0123	0.0802	0.0942	-0.313	0.0946	0.496	0.401	-0.324	-0.295	-0.324	0.00370	-0.333	-0.294	-0.864*
	(0.43)	(0.03)	(0.15)	(0.23)	(-0.77)	(0.25)	(1.31)	(0.75)	(-0.71)	(-0.79)	(-0.80)	(0.01)	(-1.01)	(-0.85)	(-2.13)
cut1	-4.190***	-3.472***	-4.267***	-4.700***	-3.317***	-3.895***	-3.771***	-4.734***	-5.748***	-4.358***	-4.402***	-4.449***	-2.570***	-1.684***	-3.600***
	(-3.44)	(-5.84)	(-3.47)	(-4.03)	(-5.21)	(-4.95)	(-6.05)	(-3.88)	(-4.50)	(-5.02)	(-5.32)	(-3.68)	(-5.69)	(-5.22)	(-5.94)
ut2	-3.481***	-2.294***	-2.841***	-3.995***	-2.365***	-3.481***	-2.740***	-4.030***	-4.634***	-3.221***	-2.706***	-3.748***	-1.375***	-0.519	-2.741***
	(-3.49)	(-5.07)	(-3.89)	(-4.66)	(-4.71)	(-5.26)	(-6.30)	(-4.39)	(-5.51)	(-5.70)	(-6.57)	(-4.22)	(-3.45)	(-1.61)	(-5.52)
cut3	-2.530***	-1.640***	-1.854**	-2.552***	-1.699***	-2.453***	-1.581***	-3.314***	-3.911***	-2.781***	-2.040***	-2.625***	-0.808*	0.169	-2.421***
	(-3.65)	(-3.53)	(-3.03)	(-5.21)	(-3.65)	(-5.14)	(-4.50)	(-4.54)	(-6.02)	(-5.92)	(-5.64)	(-4.71)	(-2.13)	-(0.53)	(-4.90)
cut4	-0.713	-0.57	-0.724	-1.581***	-0.131	-1.147**	0.418	-2.716***	-3.151***	-1.700***	-0.657*	-0.814	0.355	1.125**	-1.668***
	(-1.38)	(-1.30)	(-1.40)	(-3.83)	(-0.31)	(-2.84)	-(1.22)	(-4.55)	(-5.78)	(-3.93)	(-2.07)	(-1.80)	-(0.92)	-(3.19)	(-3.81)
cut5		0.412		-0.0362	0.996*	0.757		-0.811	-0.845	-0.574	0.642*		1.356**	2.048***	-0.151
		-(0.95)		(-0.09)	-(2.35)	-(1.91)		(-1.75)	(-1.93)	(-1.53)	-(2.04)		-(2.94)	-(4.80)	(-0.39)
cut6		2.016***			2.665***					0.991**	2.537***		4.127***	3.418***	1.557***
		-(4.14)			-(5.20)					-(2.67)	-(5.47)		-(3.84)	-(5.75)	-(3.63)
$\chi2$ (df_m)	3.583(6)	3.047(6)	5.688(6)	2.107(6)	11.01(6)	2.232(6)	3.591(6)	6.481(6)	7.240(6)	2.835(6)	6.011(6)	3.089(6)	7.382(6)	15.59(6)	18.24(6)
Prob ($\chi2$)	0.733	0.803	0.459	0.910	0.0880	0.897	0.732	0.372	0.299	0.829	0.422	0.798	0.287	0.0161	0.00565
Pseudo R^2	0.0234	0.00588	0.0282	0.00906	0.0323	0.00718	0.0117	0.0328	0.0256	0.00836	0.0152	0.0191	0.0157	0.0405	0.0416
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.5 - Product basket - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

	HEALTH					ENVIRONMENT					CONVENTIONAL				
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
BASK_Man	1.117	0.368	0.640	0.209	0.643	0.422	0.217	0.596	-0.340	0.175	0.526	0.853	0.0644	0.246	0.741
	(1.74)	(0.92)	(1.11)	(0.54)	(1.64)	(1.07)	(0.56)	(1.21)	(-0.82)	(0.48)	(1.40)	(1.47)	(0.17)	(0.63)	(1.65)
BASK_Group	0.236	-0.0836	-0.566	-0.293	0.164	-0.173	-0.121	-0.639	-0.226	-0.583	0.120	-0.600	-0.615	-0.206	-0.648
	(0.48)	(-0.24)	(-1.12)	(-0.72)	(0.45)	(-0.46)	(-0.33)	(-1.49)	(-0.59)	(-1.62)	(0.34)	(-1.38)	(-1.60)	(-0.57)	(-1.87)
BASK_Pman	-0.231	0.558	-0.205	-0.948	1.013*	-0.0807	-0.457	-1.173*	-1.061*	0.522	-0.385	0.663	0.406	0.651	0.342
	(-0.39)	(1.21)	(-0.36)	(-1.79)	(2.20)	(-0.15)	(-0.96)	(-2.41)	(-2.29)	(1.37)	(-0.66)	(0.99)	(0.95)	(1.48)	(0.72)
BASK_Assem	0.202	-0.183	0.172	-0.0306	-0.581	0.312	-0.211	0.269	-0.252	-0.0510	-0.0125	0.325	-0.772*	-0.597	-0.774*
	(0.42)	(-0.57)	(0.35)	(-0.08)	(-1.52)	(0.83)	(-0.61)	(0.61)	(-0.68)	(-0.15)	(-0.04)	(0.71)	(-2.09)	(-1.75)	(-2.08)
BASK_Net	-0.405	0.171	-0.305	-0.412	-0.564	0.760	0.266	0.765	0.935	0.123	-0.970	1.135	-0.381	-0.561	-0.981
	(-0.61)	(0.31)	(-0.37)	(-0.53)	(-0.97)	(0.78)	(0.29)	(0.91)	(1.43)	(0.22)	(-1.65)	(0.93)	(-0.71)	(-0.92)	(-1.92)
BASK_Pres	0.130	0.148	-0.386	-0.303	-0.287	0.0239	0.580	-0.153	-0.445	-0.0661	-0.884	0.131	-0.428	-0.336	-0.527
	(0.21)	(0.34)	(-0.68)	(-0.67)	(-0.70)	(0.06)	(1.41)	(-0.29)	(-0.89)	(-0.14)	(-1.93)	(0.27)	(-1.11)	(-0.79)	(-1.14)
cut1	-4.495***	-3.339***	-4.960***	-5.203***	-3.386***	-3.829***	-3.815***	-5.059***	-5.424***	-4.257***	-4.372***	-4.529***	-2.718***	-1.824***	-3.619***
	(-3.65)	(-5.47)	(-3.93)	(-4.26)	(-5.34)	(-4.98)	(-6.06)	(-4.09)	(-4.41)	(-5.04)	(-5.33)	(-3.80)	(-5.06)	(-5.26)	(-6.41)
cut2	-3.791***	-2.159***	-3.546***	-4.503***	-2.437***	-3.414***	-2.787***	-4.360***	-4.306***	-3.119***	-2.677***	-3.827***	-1.505**	-0.715*	-2.747***
	(-3.75)	(-5.07)	(-4.55)	(-4.84)	(-4.58)	(-5.31)	(-6.78)	(-4.54)	(-5.34)	(-5.76)	(-6.55)	(-4.19)	(-3.20)	(-2.07)	(-5.70)
cut3	-2.841***	-1.505***	-2.571***	-3.048***	-1.775***	-2.396***	-1.634***	-3.648***	-3.577***	-2.680***	-2.006***	-2.696***	-0.913*	-0.0754	-2.419***
	(-4.15)	(-3.72)	(-4.02)	(-5.50)	(-3.66)	(-5.32)	(-4.92)	(-4.86)	(-6.08)	(-5.84)	(-5.56)	(-4.49)	(-2.04)	(-0.22)	(-5.23)
cut4	-1.016*	-0.436	-1.439**	-2.058***	-0.224	-1.096**	0.372	-3.051***	-2.815***	-1.592***	-0.587*	-0.849*	0.317	0.820*	-1.663***
	(-2.03)	(-1.19)	(-2.80)	(-4.33)	(-0.56)	(-2.85)	(-1.16)	(-5.12)	(-5.87)	(-3.66)	(-1.97)	(-2.01)	(-0.73)	(-2.23)	(-3.97)
cut5		0.551		-0.485	0.892*	0.830*		-1.101*	-0.517	-0.442	0.731*		1.361**	1.728***	-0.202
		(-1.52)		(-1.17)	(-2.27)	(-2.18)		(-2.46)	(-1.29)	(-1.18)	(-2.47)		(-2.84)	(-4.00)	(-0.53)
cut6		2.166***			2.567***					1.145**	2.628***		4.160***	3.092***	1.456***
		(-4.93)			(-5.17)					(-3.09)	(-5.43)		(-3.90)	(-4.98)	(-3.32)
$\chi 2$ (df_m)	3.693(6)	3.139(6)	4.958(6)	5.580(6)	8.838(6)	2.480(6)	4.921(6)	12.00(6)	6.330(6)	5.737(6)	12.75(6)	8.071(6)	15.46(6)	9.684(6)	20.81(6)
Prob ($\chi 2$)	0.718	0.791	0.549	0.472	0.183	0.871	0.554	0.0619	0.387	0.453	0.0472	0.233	0.0169	0.139	0.00199
Pseudo R^2	0.0269	0.00746	0.0232	0.0200	0.0282	0.0107	0.0131	0.0470	0.0269	0.0141	0.0229	0.0418	0.0312	0.0209	0.0503
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.6 - Products planning - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

	HEALTH					ENVIRONMENT					CONVENTIONAL				
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
PRODPLAN_Man	0.412	0.527	0.475	0.391	0.245	0.33	-0.00281	1.802	0.0359	1.038*	1.034	15.03***	-0.0565	0.403	0.637
	-(0.48)	-(0.85)	-(0.60)	-(0.65)	-(0.40)	-(0.53)	(-0.00)	-(1.67)	-(0.07)	-(2.07)	-(1.77)	-(41.05)	(-0.09)	-(0.61)	-(0.84)
PRODPLAN_Group	-0.567	0.539	-0.567	-0.0113	-0.62	0.576	-0.124	-0.159	-0.268	-0.348	-0.316	0.464	-0.344	-0.0773	-0.852
	(-0.94)	(-0.95)	(-0.97)	(-0.02)	(-1.43)	(-1.00)	(-0.24)	(-0.28)	(-0.55)	(-0.70)	(-0.67)	(-0.56)	(-0.72)	(-0.15)	(-1.89)
PRODPLAN_Pman	-0.16	1.000	-0.814	-0.965	1.078	0.193	0.519	-0.775	-0.278	0.999	0.099	-0.326	0.23	-0.0673	0.507
	(-0.21)	-(1.63)	(-1.04)	(-1.56)	-(1.33)	-(0.25)	(-0.98)	(-1.14)	(-0.40)	-(1.42)	(-0.12)	(-0.50)	-(0.41)	(-0.08)	-(0.65)
PRODPLAN_Assem	0.364	-0.283	0.0485	-0.579	-0.613	-0.22	-0.355	-0.138	0.166	-0.0952	-0.139	-0.374	-0.659	-0.675	-0.419
	-(0.60)	(-0.67)	-(0.10)	(-1.21)	(-1.59)	(-0.55)	(-0.98)	(-0.30)	-(0.35)	(-0.23)	(-0.30)	(-0.70)	(-1.69)	(-1.46)	(-0.97)
PRODPLAN_Net	15.01***	-0.733**	14.01***	13.77***	0.608	-0.47	-0.475	13.80***	0.858	0.731*	0.33	14.80***	1.123	-0.985	0.176
	-(21.87)	(-2.58)	-(20.31)	-(21.84)	-(0.82)	(-0.49)	(-0.43)	-(21.42)	-(0.72)	-(2.39)	-(0.40)	-(22.39)	-(1.44)	(-1.02)	-(0.24)
PRODPLAN_Pres	-0.13	0.576	-0.532	-0.199	0.093	-0.45	-0.0975	0.00173	0.164	-0.359	-0.973	-0.414	-0.676	-0.395	-1.320**
	(-0.19)	-(1.24)	(-0.82)	(-0.35)	-(0.16)	(-0.97)	(-0.23)	(0.00)	-(0.26)	(-0.53)	(-1.75)	(-0.75)	(-1.51)	(-0.95)	(-2.62)
cut1	-4.796***	-3.273***	-4.981***	-5.025***	-3.288***	-4.131***	-3.794***	-4.817***	-4.794***	-4.054***	-4.268***	-4.812***	-2.117***	-1.564***	-3.050***
	(-4.53)	(-5.84)	(-4.58)	(-4.72)	(-6.31)	(-5.57)	(-6.01)	(-4.54)	(-4.61)	(-5.26)	(-5.49)	(-4.54)	(-6.13)	(-6.30)	(-6.99)
cut2	-4.095***	-2.104***	-3.559***	-4.325***	-2.351***	-3.716***	-2.771***	-4.116***	-3.679***	-2.912***	-2.573***	-4.111***	-0.928***	-0.487*	-2.179***
	(-5.20)	(-6.43)	(-6.19)	(-5.44)	(-6.44)	(-6.19)	(-6.75)	(-5.21)	(-5.88)	(-6.50)	(-6.50)	(-5.21)	(-3.41)	(-2.20)	(-6.47)
cut3	-3.156***	-1.458***	-2.579***	-2.879***	-1.698***	-2.691***	-1.626***	-3.407***	-2.960***	-2.474***	-1.891***	-2.976***	-0.355	0.145	-1.853***
	(-6.20)	(-5.12)	(-5.98)	(-6.78)	(-5.53)	(-6.87)	(-5.38)	(-5.56)	(-6.50)	(-6.80)	(-6.15)	(-6.19)	(-1.40)	(-0.65)	(-6.07)
cut4	-1.348***	-0.354	-1.451***	-1.889***	-0.201	-1.391***	0.358	-2.818***	-2.214***	-1.382***	-0.491*	-1.126***	0.815**	1.027***	-1.121***
	(-4.64)	(-1.39)	(-4.72)	(-6.26)	(-0.83)	(-5.09)	(-1.48)	(-5.85)	(-6.53)	(-4.82)	(-2.12)	(-4.01)	(-3.06)	(-4.04)	(-4.42)
cut5		0.656*		-0.299	0.879***	0.524*		-0.919***	0.00533	-0.242	0.802***		1.821***	1.917***	0.276
		(-2.49)		(-1.31)	-(3.44)	(-2.22)		(-3.32)	-(0.02)	(-0.99)	(-3.37)		(-5.41)	(-5.92)	-(1.18)
cut6		2.271***			2.524***					1.355***	2.725***		4.612***	3.271***	1.903***
		-(6.69)			-(6.57)					-(4.95)	-(6.33)		-(4.45)	-(6.09)	-(5.91)
χ2 (df_m)	528.6 (6)	15.51 (6)	472.5 (6)	527.4 (6)	7.288 (6)	3.074 (6)	2.492 (6)	505.6 (6)	1.021 (6)	11.51 (6)	6.072 (6)	2037.1 (6)	8.972 (6)	5.326 (6)	13.21 (6)
Prob (χ2)	5.71E-111	0.0166	6.93E-99	1.04E-110	0.295	0.8	0.869	5.11E-106	0.985	0.0738	0.415	0	0.175	0.503	0.0397
Pseudo R^2	0.0174	0.0132	0.0217	0.0296	0.0168	0.00916	0.00575	0.0387	0.00399	0.0199	0.0185	0.0651	0.0167	0.0108	0.0296
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.7 - Purchasing planning - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

	HEALTH					ENVIRONMENT					CONVENTIONAL				
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
PURCHPLA_Man	0.167	0.324	0.128	0.0336	0.0844	0.199	0.191	0.565	-0.355	-0.283	0.456	0.585	0.0586	0.0237	0.428
	(0.30)	(0.83)	(0.24)	(0.08)	(0.22)	(0.48)	(0.52)	(1.17)	(-0.96)	(-0.73)	(1.33)	(1.02)	(0.15)	(0.06)	(1.11)
PURCHPLAN_Group	-0.588	0.317	-0.376	0.0850	-0.324	0.424	-0.0411	-0.164	-0.296	-1.083**	-0.167	-0.128	-0.384	0.308	-1.054**
	(-1.21)	(0.82)	(-0.77)	(0.22)	(-0.90)	(0.98)	(-0.10)	(-0.33)	(-0.77)	(-3.20)	(-0.46)	(-0.24)	(-0.96)	(0.79)	(-2.90)
PURCHPLA_Pman	-0.459	0.517	0.00909	-0.0941	0.250	0.285	0.359	0.200	0.0527	-0.122	-0.532	0.119	-0.263	0.708*	-0.392
	(-0.92)	(1.48)	(0.02)	(-0.25)	(0.74)	(0.75)	(0.99)	(0.43)	(0.15)	(-0.34)	(-1.57)	(0.24)	(-0.76)	(2.16)	(-1.13)
PURCHPLAN_Assem	0.304	-0.523	0.0506	-0.0255	-0.873*	0.248	0.153	0.229	-0.230	-0.516	0.0344	-0.456	-0.867*	-0.786*	-0.737*
	(0.67)	(-1.53)	(0.11)	(-0.07)	(-2.31)	(0.68)	(0.42)	(0.55)	(-0.66)	(-1.52)	(0.11)	(-1.00)	(-2.44)	(-2.34)	(-2.19)
PURCHPLAN_Net	0.461	0.675	0.870	0.514	0.230	0.745	0.120	-0.191	-0.302	0.273	-0.142	0.994	-0.601	0.272	-0.164
	(0.69)	(1.24)	(1.05)	(0.84)	(0.42)	(1.50)	(0.25)	(-0.36)	(-0.65)	(0.79)	(-0.33)	(1.22)	(-1.49)	(0.65)	(-0.32)
PURCHPLAN_Pres	0.239	0.176	-0.0932	0.246	-0.279	0.131	0.564	0.128	0.113	-0.256	-0.420	0.136	-0.462	-0.271	-0.64
	(0.46)	(0.46)	(-0.19)	(0.61)	(-0.82)	(0.34)	(1.49)	(0.28)	(0.28)	(-0.65)	(-1.10)	(0.29)	(-1.20)	(-0.70)	(-1.49)
cut1	-4.950***	-3.196***	-4.818***	-4.696***	-3.735***	-3.571***	-3.285***	-4.542***	-5.140***	-5.036***	-4.463***	-4.819***	-2.846***	-1.429***	-2.849***
	(-3.76)	(-5.46)	(-3.67)	(-3.94)	(-5.75)	(-4.54)	(-4.83)	(-3.69)	(-4.19)	(-5.17)	(-5.47)	(-3.73)	(-5.68)	(-3.77)	(-4.94)
cut2	-4.250***	-2.004***	-3.409***	-3.995***	-2.800***	-3.157***	-2.256***	-3.840***	-4.027***	-3.895***	-2.773***	-4.120***	-1.624***	-0.298	-2.008***
	(-3.94)	(-4.38)	(-4.51)	(-4.62)	(-5.43)	(-4.73)	(-4.59)	(-3.98)	(-4.85)	(-5.92)	(-5.96)	(-4.29)	(-3.79)	(-0.81)	(-4.30)
cut3	-3.308***	-1.331**	-2.442***	-2.562***	-2.147***	-2.132***	-1.097**	-3.127***	-3.307***	-3.447***	-2.107***	-2.985***	-1.039*	0.365	-1.697***
	(-4.02)	(-2.90)	(-3.59)	(-5.47)	(-4.54)	(-4.15)	(-2.82)	(-3.91)	(-5.34)	(-6.35)	(-4.62)	(-4.66)	(-2.44)	(-0.99)	(-3.79)
cut4	-1.484*	-0.225	-1.322*	-1.596***	-0.578	-0.817	0.906*	-2.534***	-2.557***	-2.326***	-0.733	-1.152*	0.167	1.286***	-1.002*
	(-2.55)	(-0.56)	(-2.24)	(-3.72)	(-1.43)	(-1.92)	(-2.41)	(-4.00)	(-5.01)	(-4.83)	(-1.92)	(-2.08)	(-0.40)	(-3.42)	(-2.41)
cut5		0.778		-0.0579	0.54	1.123**		-0.669	-0.319	-1.130**	0.547		1.208**	2.191***	0.352
		-(1.96)		(-0.14)	-(1.35)	-(2.61)		(-1.32)	(-0.73)	(-2.61)	-(1.46)		-(2.61)	-(5.11)	-(0.89)
cut6		2.421***			2.173***					0.516	2.432***		3.993***	3.536***	1.950***
		-(5.32)			-(4.69)					-(1.24)	-(4.73)		-(3.89)	-(6.03)	-(4.09)
$\chi2$ (df_m)	3.397(6)	7.489(6)	1.839(6)	1.832(6)	10.46(6)	3.715(6)	3.626(6)	2.326(6)	2.316(6)	18.24(6)	5.537(6)	5.843(6)	11.69(6)	9.644(6)	18.64(6)
Prob ($\chi2$)	0.758	0.278	0.934	0.934	0.107	0.715	0.727	0.887	0.888	0.00566	0.477	0.441	0.0694	0.140	0.00483
Pseudo R^2	0.0194	0.0201	0.0118	0.00608	0.0251	0.0150	0.0123	0.0127	0.00815	0.0331	0.0120	0.0302	0.0270	0.0248	0.0456
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.8 - Purchasing orders - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

			HEALTH					ENVIRONMENT					CONVENTIONAL		
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
PURCHORD_Man	0.262	0.329	0.725	-0.738	0.464	-0.126	0.0734	0.734	-0.279	-0.284	0.565	1.026	-0.195	-0.391	0.468
	(0.37)	(0.65)	(0.92)	(-1.45)	(0.92)	(-0.29)	(0.15)	(1.13)	(-0.59)	(-0.54)	(1.03)	(1.32)	(-0.38)	(-0.81)	(0.79)
PURCHORD_Group	0.146	0.129	-0.0119	0.456	0.103	0.305	-0.106	-0.334	0.142	-0.0645	0.406	0.518	-0.122	0.426	-0.601
	(0.29)	(0.39)	(-0.03)	(1.21)	(0.28)	(0.79)	(-0.28)	(-0.71)	(0.37)	(-0.17)	(1.10)	(0.90)	(-0.33)	(1.09)	(-1.77)
PURCHORD_Pman	-0.395	-0.372	-0.269	0.205	0.293	0.539	0.431	-0.163	-0.462	-0.0393	-0.0885	-0.185	0.00528	0.670	0.0402
	(-0.81)	(-1.05)	(-0.59)	(0.55)	(0.89)	(1.39)	(1.17)	(-0.41)	(-1.22)	(-0.11)	(-0.24)	(-0.41)	(0.01)	(1.86)	(0.11)
PURCHORD_Assem	0.145	-0.151	0.262	0.254	-0.463	-0.226	0.227	-0.00934	-0.608	0.314	0.503	0.0274	-0.0548	-0.402	-0.025
	(0.24)	(-0.36)	(0.46)	(0.55)	(-1.22)	(-0.52)	(0.51)	(-0.02)	(-1.45)	(0.68)	(0.99)	(0.05)	(-0.11)	(-0.77)	(-0.06)
PURCHORD_Net	0.862	0.527	0.732	0.618	-0.479	1.356*	0.530	0.551	-0.269	0.319	-0.349	0.0425	-0.653	0.114	0.395
	(0.80)	(0.66)	(0.61)	(0.99)	(-0.52)	(2.20)	(1.01)	(0.69)	(-0.48)	(0.74)	(-0.56)	(0.05)	(-1.38)	(0.17)	(0.56)
PURCHORD_Pres	-0.102	0.0541	-0.0157	0.0640	0.148	0.408	0.398	0.488	-0.273	-0.574	-0.415	-0.170	-0.439	-0.0454	-0.312
	(-0.18)	(0.12)	(-0.03)	(0.15)	(0.42)	(1.07)	(0.98)	(0.84)	(-0.57)	(-1.37)	(-0.88)	(-0.33)	(-1.01)	(-0.12)	(-0.82)
cut1	4.950***	-3.531***	4.833***	-4.596***	-3.000***	-3.633***	-3.333***	-4.831***	-5.355***	-4.243***	-4.033***	-4.732***	-2.098***	-1.014**	2.849***
	(-4.63)	(-6.23)	(-4.52)	(-4.37)	(-5.30)	(-4.48)	(-5.15)	(-4.57)	(-4.88)	(-5.24)	(-4.80)	(-4.47)	(-4.66)	(-3.09)	(-4.94)
cut2	4.248***	-2.364***	3.422***	-3.896***	-2.059***	-3.218***	-2.299***	-4.126***	-4.244***	-3.105***	-2.345***	-4.031***	-0.919*	0.0815	2.008***
	(-4.70)	(-5.26)	(-4.90)	(-4.80)	(-4.62)	(-4.70)	(-4.69)	(-5.61)	(-5.54)	(-5.38)	(-4.86)	(-5.90)	(-2.30)	(-0.24)	(-4.30)
cut3	3.303***	-1.719***	2.452***	-2.447***	-1.411***	-2.182***	-1.140**	-3.412***	-3.528***	-2.665***	-1.676***	-2.900***	-0.355	0.731*	1.697***
	(-5.53)	(-4.29)	(-4.47)	(-4.69)	(-3.77)	(-4.40)	(-2.98)	(-5.49)	(-5.81)	(-5.33)	(-3.84)	(-6.29)	(-0.91)	(-2.08)	(-3.79)
cut4	1.494***	-0.639	-1.332**	-1.467***	0.0692	-0.853*	0.850*	-2.820***	-2.769***	-1.576***	-0.314	-1.088**	0.787	1.636***	-1.002*
	(-3.48)	(-1.80)	(-2.97)	(-3.39)	-(0.21)	(-2.12)	(-2.30)	(-6.06)	(-5.63)	(-3.84)	(-0.86)	(-2.67)	-(1.95)	-(4.30)	(-2.41)
cut5		0.35		0.0843	1.121**	1.105**		-0.950*	-0.485	-0.454	0.950**		1.776***	2.539***	0.352
		-(1.01)		-(0.22)	-(3.27)	-(2.74)		(-2.57)	(-1.28)	(-1.17)	-(2.63)		-(3.85)	-(5.73)	-(0.89)
cut6		1.960***			2.727***					1.100**	2.851***		4.547***	3.886***	1.950***
		-(4.99)			-(6.36)					-(2.67)	-(5.87)		-(4.33)	-(6.14)	-(4.09)
$\chi2$ (df_m)	1.606(6)	2.263(6)	1.901(6)	4.431(6)	3.725(6)	8.590(6)	3.283(6)	3.318(6)	5.030(6)	3.257(6)	3.965(6)	3.644(6)	4.670(6)	5.448(6)	5.980(6)
Prob ($\chi2$)	0.952	0.894	0.929	0.619	0.714	0.198	0.773	0.768	0.540	0.776	0.681	0.725	0.587	0.488	0.425
Pseudo R^2	0.0133	0.00664	0.0126	0.0147	0.00893	0.0254	0.0104	0.0167	0.0178	0.00791	0.0113	0.0193	0.00826	0.0156	0.0129
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

*Table A.9 - Logistic - OGLM estimates by positions and resources uses objectives (t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001)*

			HEALTH					ENVIRONMENT					CONVENTIONAL			
	SAFETY	DIRECTING	NORESID	NOPRESERV	BABYFOOD	PRODZONE	CLOSEZONE	ENVIMP	ENHLOG	TRADGEN	LOWPRICE	SOCRESP	ELABFOOD	AVAILAB	TRADIT
LOGIST_Man	1.299	0.485	0.817	-0.352	0.370	0.125	0.0967	0.666	-0.227	0.0512	0.394	0.543	-0.107	0.158	0.43
	(1.64)	(1.25)	(1.27)	(-0.84)	(0.91)	(0.31)	(0.21)	(1.33)	(-0.54)	(0.12)	(0.90)	(0.92)	(-0.26)	(0.37)	(1.00)
LOGIST_Group	0.381	0.0179	-0.147	0.498	-0.379	-0.217	-0.0472	0.334	0.438	-0.250	-0.280	0.928	-0.814*	-0.535	-0.892*
	(0.77)	(0.06)	(-0.32)	(1.30)	(-1.06)	(-0.60)	(-0.13)	(0.79)	(1.17)	(-0.74)	(-0.80)	(1.80)	(-2.44)	(-1.52)	(-2.56)
LOGIST_Pman	-0.778	-0.343	0.135	0.339	0.348	0.329	0.271	0.362	-0.300	-0.122	0.0307	0.164	-0.237	0.536	0.306
	(-1.53)	(-1.00)	(0.30)	(0.95)	(1.09)	(0.92)	(0.78)	(0.90)	(-0.84)	(-0.34)	(0.09)	(0.38)	(-0.71)	(1.65)	(0.88)
LOGIST_Assem	0.740	-0.637	0.339	0.291	-0.872*	-0.253	-0.325	0.309	-0.407	0.0937	-0.196	0.151	-0.656	-1.154**	-0.231
	(1.18)	(-1.75)	(0.68)	(0.69)	(-2.29)	(-0.73)	(-0.84)	(0.67)	(-0.99)	(0.22)	(-0.52)	(0.28)	(-1.55)	(-2.59)	(-0.55)
LOGIST_Net	-0.182	1.137*	1.692	0.743	-0.194	0.921	0.0555	-0.105	-0.241	0.224	-0.217	0.915	0.00768	0.555	-0.198
	(-0.31)	(2.27)	(1.48)	(1.43)	(-0.39)	(1.77)	(0.12)	(-0.22)	(-0.56)	(0.62)	(-0.51)	(1.09)	(0.02)	(1.37)	(-0.42)
LOGIST_Pres	-0.218	0.219	0.0117	0.448	0.434	0.00894	0.176	-0.0369	-0.149	-0.377	-0.223	-0.262	0.0255	0.265	-0.255
	(-0.41)	(0.53)	(0.02)	(1.00)	(1.16)	(0.02)	(0.43)	(-0.07)	(-0.34)	(-1.00)	(-0.50)	(-0.53)	(0.07)	(0.72)	(-0.63)
	-		-											-	-
cut1	4.982***	-3.560***	4.445***	-4.292***	-3.278***	-3.949***	-3.601***	-4.342***	-5.113***	-4.282***	-4.284***	-4.315***	-2.539***	1.457***	2.977***
	(-4.52)	(-6.87)	(-4.15)	(-4.10)	(-5.21)	(-4.69)	(-5.80)	(-4.13)	(-4.66)	(-5.35)	(-4.90)	(-4.06)	(-5.78)	(-4.50)	(-5.48)
	-		-												-
cut2	4.277***	-2.373***	3.032***	-3.591***	-2.342***	-3.536***	-2.578***	-3.641***	-3.996***	-3.149***	-2.599***	-3.615***	-1.325***	-0.307	2.119***
	(-4.48)	(-5.17)	(-4.10)	(-4.49)	(-4.90)	(-4.99)	(-5.55)	(-4.92)	(-5.97)	(-5.55)	(-5.48)	(-4.95)	(-3.54)	(-1.06)	(-4.86)
	-		-												-
cut3	3.328***	-1.710***	2.057***	-2.146***	-1.685***	-2.514***	-1.433***	-2.929***	-3.276***	-2.717***	-1.934***	-2.488***	-0.752*	0.369	1.802***
	(-5.10)	(-3.89)	(-3.79)	(-4.49)	(-4.36)	(-5.14)	(-4.11)	(-4.85)	(-5.73)	(-5.31)	(-4.50)	(-5.77)	(-2.10)	-(1.25)	(-4.36)
cut4	-1.458**	-0.596	-0.918*	-1.168**	-0.149	-1.194**	0.549	-2.340***	-2.520***	-1.642***	-0.577	-0.641	0.422	1.301***	-1.088**
	(-2.98)	(-1.45)	(-2.16)	(-3.03)	(-0.43)	(-3.07)	-(1.62)	(-4.90)	(-5.52)	(-4.24)	(-1.56)	(-1.58)	-(1.18)	-(4.20)	(-2.88)
cut5		0.439		0.408	0.941*	0.754		-0.469	-0.255	-0.521	0.682		1.434***	2.209***	0.303
		-(1.05)		-(1.17)	-(2.56)	-(1.94)		(-1.29)	(-0.68)	(-1.50)	-(1.85)		-(3.44)	-(5.97)	-(0.81)
cut6		2.142***			2.580***					1.032**	2.561***		4.213***	3.556***	1.916***
		-(4.41)			-(6.05)					-(2.88)	-(5.40)		-(4.04)	-(5.94)	-(4.25)
$\chi2$ (d_m)	5.784(6)	10.91(6)	5.732(6)	9.334(6)	10.59(6)	5.808(6)	1.745(6)	4.154(6)	4.453(6)	4.300(6)	3.323(6)	6.878(6)	9.345(6)	14.8(6)	8.41(6)
Prob ($\chi2$)	0.448	0.0911	0.454	0.156	0.102	0.445	0.942	0.656	0.616	0.636	0.767	0.332	0.155	0.0219	0.21
Pseudo R^2	0.0570	0.0288	0.0352	0.0263	0.0221	0.0162	0.00528	0.0180	0.0152	0.00591	0.00657	0.0420	0.0214	0.0317	0.0224
N. obs.	125	122	124	123	120	123	124	124	123	120	124	125	115	123	121

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Fostering the debate among scholars to support the advancement of knowledge in the food-related consumer research: A commentary

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A Babbù

Abstract

In this commentary, I aim to highlight some issues currently challenging the advancement of knowledge in the food-related consumer research academic community. Retracing the sections of a research paper, several strategic writing practices authors use to please reviewers are outlined together with customary referee comments considerably popular nowadays (as paper originality; sample size and external validity; and risk of bias). These odds in the current publishing and reviewing practices, which are also under transition and in an ongoing shift, need thorough discussion among the academic community. The overall goal of the commentary is to foster debate and reflection among editors and scholars to better define the possible boundaries of good contributions to knowledge and the precise guidelines to prevent (potentially) detrimental practices on both sides.

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Introduction

Before starting, I upfront assert my profound appreciation of the peer-review process, which is the keystone of research dissemination, and my truthful persuasion that in an overwhelming number of cases anonymous reviewers effectively enhance manuscripts. Nevertheless, recently I realized that I begin most of the prospective articles writing the limitations section. This is not due to the feeling that the limits of the research are a key issue of the manuscripts, wherefore, I am quite aware of the customary remarks that most reviewers will rise. Let me be straightforward, certainly all consumer-related research has limitations (and even more my manuscripts) and it is surely appropriate to highlight these shortcomings to readers. However, the vicious circle fostered by prejudicial assessments of research outputs is worrying, as reviewers could scrutinize some aspects of my study more than others. Hence, I plan my research accordingly and apply unwritten golden rules of strategic writing to please them. Strong exemplars are the ubiquitous use of scales to measure various information, the application of sophisticated econometric models to explain simple relations between collected data, and the mandatory objective to produce innovative findings.

Here, I briefly discuss the key shortcomings stemming from these practices and present a set of reviewers' usual remarks, which in a similar way (often) challenge knowledge advancement[1].

This commentary neither aims to address how reviewers should perform their job, nor aims to provide guidelines for authors in academic publishing. Additionally, it is not a critical discussion of the peer review process which I strongly bear as the building block of scientific dissemination. Instead, my overriding objective is to stimulate a discussion and reflection among scholars on some issues that are (in my view) hampering current food-related consumer research. Furthermore, the final aim is not to embrace the author's view or the reviewer's view, but to foster a reflection on what we should consider a good contribution to science. I also openly acknowledge that I have not performed a systematic review to identify the practices hereafter described and thus might be (heavily) biased by my personal experience[2].

However, the starting point could involve defining the goals of applied research (Levy and Grewal, 2007). Based on Brown and Dant (2008),

1. Nonetheless, since multiple reviewers evaluate manuscripts a certain balance or relieve of certain biases certainly occurs.

2. As noted by an anonymous reviewer, probably most of the issues included in the commentary apply (generally) to many types of research. Nevertheless, since my personal experience is related only to food-related research I do not feel comfortable to extend it beyond these boundaries.

food-related consumer research should: add new knowledge, deepen the understanding of existing knowledge, provide surprising results, or shed light on new problems of interest to scholars and practitioners. If we concur on these key objectives of applied research, the first important consideration is that "relevant" would not necessarily imply "novel". Using the metaphor of knowledge as a "forest of knowledge trees" (Janiszewski *et al.*, 2016) knowledge creation could be considered as the addition of leaves to a tree, and not always as the starting of a new branch. Ubiquitous evidence reveals that food consumers change attitudes and behaviours over a limited time span; hence, providing updated insights is certainly useful for decision-makers and marketers. Similarly, product type, cultural contexts, consumption occasions, and socio-demographic status strongly influence individual food choices (Giacalone & Jaeger, 2019; Nijman *et al.*, 2019). Academic research is often constrained considering sample representativeness, geographical scope, product category range, and occasion of consumption; hence, findings based on different geographical and consumption contexts could offer valid, supplementary information. Moreover, results considering diverse product categories and target samples could help further test important research hypotheses. Directly stemming from these considerations, we can try to essentially understand if a study worthy of publication could be differentiated based on what it adds to current knowledge. All scholars must clearly define their study contributions and explain their importance, while we should acknowledge that studies could have relevance at an industrial or political level, and at regional, national, or international scales; moreover, they could focus on broader (or limited) food categories or consumer targets. Additionally, many "imperfections" in studies are sometimes discovered after the manuscript is published. Nevertheless, it was worth publishing at the time, allowing scholars to improve the research by continuing and deepening their investigation.

My personal view is that recently both reviewers and authors have been deviating from these parameters, shrouded by other much less important aspects.

1. Authors' strategic writing practices (the unwritten golden rules) and customary reviewer remarks

Every scholar that has planned and executed food-related consumer research is aware of the countless trade-offs faced in selecting the optimal methodology, design, and respondent sample, given budget, time, and human resource constraints (Jaeger *et al.*, 2017). The best outcome a researcher could seek is to maximize the strengths and minimize the shortcomings, achieving

– according to their goals – the highest possible internal, external, and ecological validity of findings (Plaza *et al.*, 2019).

Nevertheless, lately, it seems that some limitations are more disturbing for our peers than others; consequently, authors have developed a sort of *vademecum* to undertake food-related consumer studies to avoid acute scrutiny.

The misalignment of incentives between authors and reviewers is a well-known issue in peer-reviewing (García *et al.*, 2020). All referees are (hopefully) aware that their core role is to examine the importance of the research question and assist authors in improving their paper; however, these two tasks are often extremely challenging. Consequently, in such challenging times, a kind of shortcut has emerged in the reviewing process: a consolidated checklist of key flaws that undermine all studies. This standardized evaluation is thoroughly incongruous, as food-related consumer research could have considerably different relevance and scope; hence, it should be appraised on a case-specific basis.

Additionally, and probably even more worrying, younger scholars are naturally inclined to follow the patterns of their personal experiences and thus replicate most of the common remarks received.

Hereafter, I provide a brief compendium of some practices[3] scholars have been applying to please reviewers (and minimize potential criticisms) and outline several customary referee comments very popular nowadays, which should be better discussed in the academic community.

To effectively drive readers through the discussion, the commentary retraces the general, typical structure of research papers; pointing-out selected issues related to the research question, the methodology, the results, and conclusions. I purposely exclude the theoretical framework from the reasoning as it would involve a plethora of different stands, depending on the discipline through which the paper is observed and evaluated.

1.1. *Research question*

The first phase of all scientific research is to identify a question worthwhile of being investigated. Nevertheless, the value of the study's motivation is not an absolute concept and different scholars might strongly disagree on the meaningfulness of the same research. Indeed, there is no handbook or golden rules explaining what constitutes a good research question. However, in more general terms, the research question should be scrutinized on its relevance while recently the focus has sharply shifted towards novelty per se.

3. This inventory certainly does not exhaust the set of strategies applied.

1.2. *Originality*

All editors and reviewers in their very first evaluation of a manuscript carefully assess its originality (see, among others, Summers, 2001). However, the concept of originality is often confused with novelty. Papers that contribute and add knowledge to the scientific literature or field should be positively appraised, beyond their degree of novelty. According to the Merriam-Webster dictionary, a novel (product) is new and does not resemble something formerly known or used. In the famous presentation "how to publish an academic paper" by Bellemare (2014), he defines the quality of a manuscript as the result of optimizing the function of the research question, its novelty, and execution. Nevertheless, the idea of novelty in the consumer-related domain could be more carefully evaluated by the scholar community. The fact that nobody has previously investigated a topic is not per se a motivation for a sound research question; contrarily, the issue could indeed not be relevant (Varadarajan, 1996). Conversely, a study dealing with a highly explored matter should not be a priori disregarded just because it lacks novelty. Indeed, its findings could add significant information to current knowledge, providing insights on an underexplored market/target, or details of consumer behaviour in a new/different consumption context, or help additionally prove the effectiveness of policies dealing with specific (unexplored) product categories. I believe that the originality of food-related consumer research should be evaluated more comprehensively, also considering the specific sample and product category scope together with the occasion/context of consumption investigated and the individual variables explored. Complementing this information with the methodological approach of a study could provide a complete picture of its originality. Indeed, as underscored by one anonymous reviewer, originality can derive from different facets: the topic, the data, the scales or items applied for measurements, and the estimation methods.

1.3. *Differentiation*

As previously mentioned, academic editors and reviewers usually as a first step, scrutinize the overall importance of a study contribution (Bagchi *et al.*, 2017; Janiszewski *et al.*, 2016). Underlining the contribution of a manuscript to available literature is certainly a keystone in writing an effective scientific paper; however, authors often dwell exclusively on the distinctive features of their studies. However, (evidently) a paper's differentiation factors do not solely validate the merits of the study. Indeed, numerous papers begin with considerable lists of elements that distinguish their research from existing

studies; however, they often provide, limited (or no) information on why these characteristics could or should be of interest, adding to current knowledge. The focus should be on the meaningfulness of our studies, and not on their demarcation.

Additionally, as underlined by one reviewer, journals might assess the importance of the research question very differently. For example, interdisciplinary journals might be keener towards broader research areas/topics compared to a field journal; similarly, if a study is focused on a specific, local challenge, a regional journal could be a more suitable option. Therefore, scholars should devote greater concern to selecting the best fitting outlet for their manuscripts.

2. Methodology

The methodological section of a manuscript should effectively present the motivations (and description) of the techniques applied to gather the data and the statistical/econometric elaborations performed. However, scholars are now almost compelled to follow established patterns of data collection and processing to avoid heavy *a priori* criticism.

2.1. *Overuse of validated scales*

Validated scales undoubtedly provide useful metrics to explore specific food consumer attitudes, needs, and interests (Steptoe *et al.*, 1995; Lusk, 2011; Schnettler *et al.*, 2013), and help measure important personality traits that drive food choices (as, among others, neophobia) (van Trijp & van Kleef, 2008). However, the application of scales to grasp basic, precise information that is directly and unambiguously measurable using a simple question is now quite ubiquitous. Indeed, empirical evidence suggests that simple, single-item and straightforward questions could often present more direct (and ecologically valid) individual measurements. Most (if not all) professional consumer market analysis reports[4] such as Euromonitor, IRI, and Mintel corroborate this assumption, not applying any of these scales while providing detailed information on various drivers of everyday food choices. Briefly, one could question if the validated scales could be applied because we really believe that these constructs help effectively measure the targeted attitudes/intentions/perceptions or if these metrics are used only as an expressway to

4. These reports are well-appreciated by private companies worldwide, as demonstrated by their market value and diffusion.

publishing. In other words, even if the alphas of these final constructs are high, it is questionable if we are capturing practical information that could assist the understanding, explanation, and prediction of actual consumer behaviours. Alternatively, scholars should consider collecting data through qualitative techniques, which, however, most applied economists are not well-trained in. Once again, if research should be of high quality and relevant (Winer, 1999), the exploitation of validated scales in food-related consumer studies is somehow drifting away from the latter objective.

2.2. *Econometric sophistication*

Withholding results and selective reporting of findings (also called cherry picking/p-hacking) is a well-known issue (Banks *et al.*, 2016) and also strictly related to publication bias. Similarly, the abuse of p-values (concentrating only on statistical significance and overlooking the real-world impact of estimates) has been detected as an important limitation in several research areas (Brodeur *et al.*, 2016; Greenland *et al.*, 2016; Josephson & Michler, 2018). While p-hacking[5] occurs whenever a statistical strategy exceeds the bounds of the underlying identification strategy (Lybbert & Buccola, 2021), the malpractice I aim to underline here is a more general tendency to apply very sophisticated statistical analysis or econometric modelling to describe considerably straightforward relations. Whilst there is merit to using the most appropriate and new econometric method, as a colleague once powerfully explained, some studies apply methods that shoot sparrows with a cannon. The goal is most probably not motivated by malicious intent but twofold: 1) to showcase authors' empirical knowledge, and 2) to anticipate reviewers' data processing proposals.

Recently, pre-registration and pre-analysis plans have been advocated (and endorsed) by a share of scholars to limit cherry picking/p-hacking (Canavari *et al.*, 2019; Rommel & Weltin, 2021); however, these instruments would not effectively tackle magnified analysis. Data and code sharing could be more effective in delimiting the methodological drift of authors.

5. Lybbert and Buccola (2021, pp. 1336) also provided a more comprehensive definition called "p-hacking" writ large as "the violation knowingly or unknowingly of the principles of theoretical modeling or statistical inference with the intention of maximizing research impact, including the probability of manuscript acceptance, media attention, and subsequent citations".

3. Results

As powerfully explained by Bellemare (2020) the results section of a manuscript should allow the reader to judge the external and the internal validity of the study findings. Therefore, authors' efforts should be devoted to explaining the possibilities of their outcomes to be used for out-of-sample predictions and justify the rationale and robustness of their elaborations.

3.1. *Sample size and external validity*

Many food-related consumer research is performed on small, non-probabilistic, convenience samples; thus, the results cannot be directly transferred broadly or across populations and settings. Additionally, cross-sectional studies widely dominate longitudinal research. Nevertheless, reviewers have been increasingly demanding papers with findings that could be generalized beyond the parameters of a particular study. However, if we aim to generalize the results considering a sample to a specified larger population, sample size and representativeness are certainly core features (Lesko *et al.*, 2017)[6]; moreover, highly realistic research settings[7] provide better information about a particular phenomenon considering a particular time and place. Nevertheless, both are not particularly relevant if the ultimate goal is to generalize across populations and settings; the key component being theory (Lucas, 2003). In more general terms, we could recall again the metaphor of knowledge as a "forest of knowledge trees" (Janiszewski *et al.*, 2016) and consider that scientific knowledge is cumulative; thus, results gain an increased external validity with each successful theoretical replication. Similarly, as data are always limited to a special case of what occurred during measurements (Ahl & Allen, 1996), no study alone could produce general knowledge. Therefore, research should clearly establish the scope of its population and setting and then effectively assess the internal and external validity of its inferences (List *et al.*, 2011). Finally, and probably foremost,

6. As effectively stated by List (2020), "Where external validity refers to generalizing to the rest of the same population from which a sample is taken, increasing the sample size does improve inference. However, where external validity refers to a population of different situations or people different from the populations from which an original research sample was drawn, increasing the sample size of the original study would not necessarily improve the portability to these different populations".

7. Berkowitz and Donnerstein (1982, pp. 249) state that the "meaning the subjects assign to the situation they are in and the behavior they are carrying out plays a greater part in determining the generalizability of an experiment's outcome than does the sample's demographic representativeness".

reviewers (and authors) should devote more attention to the adequate power of statistical tests (Trafimow *et al.*, 2020). Nevertheless, if generalization either related to the methods or methodology applied is part of the research objectives, this information should be clearly stated upfront.

3.2. *Risk of bias*

Scholars are well aware that all findings are bound by numerous particulars related to data collection (as time, place, setting, and methodology) that are intrinsic limitations of studies. These are then complemented by a systematic bias that cannot be controlled by researchers but could eventually only be computed. My recent personal experience suggests that reviewers have been increasingly questioning the reliability of study findings based on the amount of uncontrolled or design-generated risks of bias detected in a manuscript[8]. If I outsource a professional marketing company to collect panel data on the drivers of preferences of regular shoppers for a food item X, I am inherently accepting some sample-selection bias. Similarly, a laboratory experiment involving multiple evaluations of food will inherently disregard numerous factors that have impacts in natural contexts. These factors may be beyond the control of an experimenter, such as environmental cues and social interactions. Nonetheless, the study findings could be highly valuable.

4. Conclusions

The final section of a research paper should provide its core real-world implications and its more relevant limitations. Thus, authors should conclude by discussing what those implications are, avoiding claims not supported by their results, debating the major shortcomings of their study, and offering some possible way forwards to extend/enrich findings (Bellemare, 2020).

4.1. *Policy and industry recommendations*

Most academic journals today emphasize the requirement of manuscripts to deliver practical insights to policymakers and practitioners. In addition, nearly all research funds are deeply bounded by numerous pragmatic

8. This issue is directly related to the abundance of study limitations (as an immediate consequence of recurrent referee remarks).

objectives and deliverables. Nevertheless, scholars often struggle in providing effective information to stakeholders, probably due to the recognised distance between academia and business (*e.g.*: Cavicchi *et al.*, 2014). Consequently, the conclusion section is sometimes curtailed by a sterile list of unachievable suggestions or recurring stereotypes. A possible solution could be involving interested parties in the interpretation and reasoning of the result together with the specific implications of the study findings.

4.2. *The power of study limitations*

It is somehow humorous that some reviewers are more wholehearted towards manuscripts that devote considerable space highlighting study limitations. Underlining the core shortcomings of research is certainly a proper, and good, practice of academic publications, however, providing a lengthy list of actual or potential threats to the internal and external validity of findings is not always very useful. First, many of these threats (population target, product category, and consumption or purchasing setting) are not study limitations but researchers' conscious choices. Second, exposing the key limitations upfront does not explain or justify why researchers deliberately decide to proceed on that path. A powerful exemplar is the use of the definition of an exploratory study, as a simple manner to lessen the criticism of problems with generalizability (Babin *et al.*, 2016). Attentive authors should clearly expose the core study limitations as precautionary measures and thus avoid the misinterpretation of the results, siding however this information with the reasons why the shortcomings could not be avoided in the performed research. For example, online data collections are inherently prone to involve a higher share of respondents with pc proficiency; nevertheless, this might be the only available manner to gather observations (as in a pandemic). Therefore, scholars should openly disclose this possible bias in the description of their sample (and eventually measure potential discrepancies from the target population) and warrant readers of the possible distortions of final outcomes.

Concluding remarks

Notwithstanding the problems of peer-reviewing, it remains the cornerstone of research dissemination (Alpert, 2007). Recent data shows that journals have experienced a significant increase in submissions after COVID-19 lockdowns began (Biondi *et al.*, 2021), alongside an increase in reviewer fatigue was evident before the pandemic, with a rise from 1.9

to 2.4 in the number of reviewer invitations required to obtain one report (Publons, 2018). Other data show a substantial decrease in the share of accepted submissions. In the field of Agricultural Economics and Policy, for example, an average acceptance rate of under 20% has been computed in the last 20 years (Finger *et al*., 2021). In such a competitive scenario, scholars are susceptible to temptations to achieve the best in their self-interests (Lybbert & Buccola, 2021).

Therefore, as a community, we should aim to foster the publication of papers based on a strong theoretical and methodological basis, solid data, and methodology, and foremost on the relevance of the research, while not focusing our attention only on the results generated (Heckelei *et al*., 2021). Additionally, adapting the famous microeconomic definition by March and Simon (1958), reviewers should not be satisfiers (checking for some pre-defined thresholds of "good studies"), but rather maximizers of contributions to research knowledge.

More efforts should be devoted by scholars, academic mentors, and journal editors to promoting the dissemination of practical, agreed guidelines for the peer-reviewing process of consumer-related manuscripts. Indeed, most of the debate around peer-reviewing pitfalls and problems is found in medical science literature; moreover, consumer-related scholars often learn to conduct reviews through trial and error, with quite limited sources providing practical instructions on how to act as a reviewer[9] (Lovejoy *et al*., 2011; Spigt & Arts, 2010).

Ideally, reviewers (should) have the same, ultimate goal as authors: disseminating meaningful research, always keeping in mind that reviewing must essentially assist authors in improving their paper.

Moreover, we should genuinely reflect on the core motivations guiding food-related consumer academic research: one could question if we are aiming to whisper in the ears of princes (Roth, 1995) – inform policymakers –, or if we are speaking to theorists, or searching for facts (Torgler, 2002), or both. Based on the answer to this, manuscripts could be valued more effectively, closely weighing their actual impact and scrutinizing their most relevant shortcomings.

Ultimately, I invite scholars to debate thoroughly how the different issues raised in the current commentary could be unraveled; should we aim to encourage authors to be more courageous and insist on their cases or modify reviewers' behaviour?

9. Recently, publishers have been providing video and audio tutorials to instruct potential reviewers; however, these instructions are quite broad and not specifically fitted for studies on food-related consumers.

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