SOCIETÀ ITALIANA
DI ECONOMIA
AGRO-ALIMENTARE

ECONOMIA AGRO-ALIMENTARE
FOOD ECONOMY

An International Journal
on Agricultural and Food Systems

2021, Vol. 23, Issue 1

FrancoAngeli
OPEN ACCESS

SIEA
SOCIETÀ ITALIANA DI
ECONOMIA AGRO-ALIMENTARE

ECONOMIA AGRO-ALIMENTARE
Food Economy

(Rivista fondata da Fausto Cantarelli)

FrancoAngeli

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Amministrazione: v.le Monza 106 - 20127 Milano - Tel. 02/2837141 - Fax abbonamenti 02/26141958 - e-mail: riviste@francoangeli.it

Registrazione del Tribunale di Reggio Emilia n. 932 del 6 novembre 1996 - Direttore Responsabile: dr. Stefano Angeli - Quadrimestrale.

I quadrimestre 2021

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Economia agro-alimentare /
Food Economy
An International Journal on Agricultural and Food Systems
Vol. 23, Iss. 1, Art. 1, pp. 1-4 - ISSN 1126-1668 - ISSNe 1972-4802
DOI: 10.3280/ecag1-2021oa11894

Editorial

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Volume 23 of *Economia agro-alimentare / Food Economy* features four regular Articles and two Notes, all written in English. The authors are affiliated with Institutions based in Italy, Spain, Germany, France, and the USA. The range of the analysis spans from local to global and covers several sectors of the food economy, such as wine, olive oil, beef. The topics span from wine consumer behaviour and preference to firms' economic performance, from value chain analysis to land ownership models and from promotion tools for disadvantaged areas to the relationships between climate and trade.

Isabella Procidano, Christine Mauracher, and Marco Valentini, in their article "Consumers' perception of Prosecco wine packaging: A pilot study in Padua and Milan", analyse the preference of consumers for graphical elements in wine labels. They present a study based on a face-to-face questionnaire and a preference ranking experiment in which wine consumers compare three bottles of Prosecco wine of the same brand. The data are analysed using the rank-ordered logit model. Results confirm that wine consumers have diversified preferences depending on several factors and that a traditional style for bottle and label is often preferred over innovative solutions.

Silvia Andrés González-Moralejo, Mildrey García Cortés, and Juan Francisco López Miquel present the article "Are small and medium-size firms in food industry profitable? Explaining differences in their performance: The case of Valencia Region", which aims to identify the main components of economic and financial profitability in the Valencia food industry in the period from 2006 to 2015. They use multivariate methods applied to micro-panel data from the SABI balance sheet database available by Bureau van Dijk. They considered both the Return on Assets and Return on Equity as the profitability measures of interest. The explanatory variables include financial and structural firm characteristics and macro-economic, location, and industry-related factors. The results show that the firm characteristics are by far the most important determinants, even though the other factors also influence profitability.

In their article titled "The economic and environmental sustainability of extra virgin olive oil supply chains: An analysis based on food miles and value chains", Biancamaria Torquati, Lucio Cecchini, Chiara Paffarini, and Massimo Chiorri present an assessment of the environmental sustainability of extra-virgin olive oil (EVOO) supply chains. They consider environmental sustainability, measured as the carbon footprint generated by the food miles (FMs), estimated through a life cycle assessment (LCA) procedure. The economic sustainability was assessed using the added value generated in each exchange along the supply chain. The data are derived from purchase diaries maintained by a small purposeful sample of households and a value chain reconstruction based on information from local industry operators in Umbria. The results show that sustainability differences between the EVOO supply chains exist, but higher sustainability is not always associated with local supply chains or higher prices. Despite the few exceptions, however, short and local supply chains, both conventional and organic, tend to allow a more equitable distribution of the added value and a lower transport-related environmental impact.

In the article "Mountain beef and wine: Italian consumers' definitions and opinions on the mountain labelling-scheme", Mikael Oliveira Linder, Katia Laura Sidali, and Gesa Busch study Italian consumers' opinions regarding beef and wine produced in mountain areas as well as their opinions concerning the new mountain labelling scheme. These topics are particularly relevant in the current debate on SDGs and Agenda 2030, as we know that mountain farming is characterised mainly by family and small-scale agriculture, which plays an important role in supporting sustainability and promoting food security and economic development. Thus, adding value to the mountain beef production using the mountain label may positively impact the economy of rural areas and represent an interesting market opportunity for rural communities. By adopting a qualitative approach,

the authors collected many observations of the interactions in different occasions between consumers on the one hand and beef and wine producers on the other hand. They also administered focus group discussions and semi-structured interviews with beef and wine consumers. Among several outputs of their research, it is worth underlining that consumer expectations about mountain products indicate a higher interest for healthier and ethical products and a strong association of these products with credence attributes. Furthermore, they emphasise the diverging views and criticisms from different consumer segments on labelling schemes and the potential market niche emerging around the concept of "mountain wine".

In the Note "Is an alternative to private property durable in agriculture?", Catherine Macombe analyses the case of the "Foncière Solidaire", created in France by the association "Terre de Liens" (TDL). This association collectively buys land to lease them to new farmers on a long-term basis, to evaluate whether the system of collective land property can be durable (that is, can be sustained over time) in that context. TDL values are analysed using the grid provided by the so-call Grammar of Justice. The analysis is based on the content analysis of the official communication of the TDL association contained in the TDL website, including the movement's charter. The author concludes that the values of TDL display the specific features of durable companies, and the "Foncière Solidaire" model could develop strongly with the support of the legislator. Therefore, according to the author, there is a potential for durable collective alternatives to individual ownership of agricultural land if fostered by policy measures.

The last article is a Note by Fabio Gaetano Santeramo, Dragan Miljkovic, and Emilia Lamonaca, titled "Agri-food trade and climate change", discussing recent issues related to the economic impacts of global climate change on international trade. After a brief discussion of the relationship between climate change and economic development and on the dual linkage between climate change and the agricultural sector, they discuss the two most common approaches used to analyse the relationship between climate and trade that is, panel methodologies and reduced form equations on one side, and simulations of the effects of climate change, based on macro and microdata, in scenarios with and without trade adjustments on the other side. The literature reports mixed results and potentially reflect divergences across countries, where some countries could lose while others could gain from the adaptation process. Less developed countries may face disadvantages and increasing inequality levels. The authors conclude that the research on the effects of climate change on trade and the global value chains should be intensified.

We believe that this issue will offer our readers interesting material to generate more ideas and further research activities.

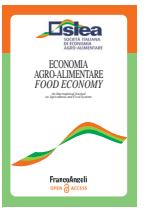
With this issue, we welcome three new members of the Editorial Board: Alessio Cavicchi, Catherine Chan, and Maro Vlachopoulou. We also welcome the new members of the Scientific Advisory Board for the current year. Altogether, the SAB counts 45 members, including scholars from institutions based in Italy (11), USA (9), International (3), UK (3), Brasil (2), France (2), Germany (2), Albania (1), Austria (1), Belgium (1), Germany & Spain (1), Greece (1), Norway (1), Poland (1), Portugal (1), Republic of Korea (1), Sweden (1), Switzerland (1), The Netherlands (1), UK & Italy (1). The updated full list of SAB members is available in the journal front matter and on the website www.economiaagroalimentare.it. The Editor-in-Chief and the Editorial Board look forward to working with our new Scientific Advisory Board.

We also have some updates regarding the journal's indexing and abstracting. The journal has been accepted in the Directory of Open Access Journals (DOAJ). The journal description is already available at the link https://doaj.org/toc/1972-4802, and the access to articles published in the Open Access issues is already active. Starting from January 2021, EBSCO will make available the full text of Economia agro-alimentare open access in its Business Source Ultimate database: www.ebsco.com/products/research-databases/business-source-ultimate. The articles' metadata will also be included in all other versions of Business Source (Elite, Premier and Complete). Finally, our publisher FrancoAngeli Edizioni has submitted the application for coverage in the Clarivate Analytics Science Citation Index/Social Sciences Citation Index and inclusion in Web of Science. We look forward to receiving their evaluation, hoping that the positive outcomes of our continued efforts to make the journal a well-known and respected outlet for high-quality research will be recognised.

Economia agro-alimentare /
Food Economy

An International Journal on Agricultural and Food Systems

Vol. 23, Iss. 1, Art. 2, pp. 1-23 - ISSN 1126-1668 - ISSNe 1972-4802
DOI: 10.3280/ecag1-2021oa11546



Consumers' perception of Prosecco wine packaging: A pilot study in Padua and Milan

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Abstract

This paper aims to illustrate and discuss the importance of packaging attributes in the wine market. A survey was conducted in the north of Italy to assess how different attributes affect the probability of choosing a bottle of Prosecco wine. Two hundred face-to-face interviews based on a structured questionnaire were administered in Milan and Padua supermarkets to elicit preferences. Each respondent ranked three new bottles of Prosecco wine and expressed the importance of different packaging characteristics in its choice. Product attributes include Label's form, Label's colours, the Label in its entirety, the Writing "Prosecco", the Band on the bottle's neck and the Bottle's shape. The interviews allowed us to recognise the bottle customers found the most attractive, and rank-ordered logistic regression was able to disentangle which packaging characteristic led to their decision.

Article info

Type:
Article
Submitted:
09/07/2019
Accepted:
11/03/2021
Available online:
31/05/2021

JEL codes:
D12, M31, L66

Keywords:
Packaging
Label
Wine
Rank-ordered logit

Managing Editor:
John Stanton

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Introduction

Nowadays, packaging is more than a way to protect a product and preserve its functions and characteristics. As a matter of fact, a package's look is the first thing attracting customers. On the one hand, well-designed packaging can arouse the customer's feelings inducing new desires that the product can satisfy. On the other hand, a product package can reassure customers by visually transmitting consistency with the values customers are looking for in their purchases (Rigaux-Bricmont, 1982; Underwood & Klein, 2002; Underwood, 2003; Wells *et al*., 2007). Finally, good packaging can help a product be more recognisable in the market, and it has an ever more strategic relevance in an ever more competitive economy (Rundh, 2009; Silayoi & Speece, 2004).

Packaging can visually synthesise and communicate important products and manufacturers' values that could hardly be transmitted in other ways. It also can help customers to choose among a variety of food items that appear similar. Attractive shape and colours are key factors to communicate the product to customers (Grossman & Wisenblit, 1999; Silayoi & Speece, 2004; Delgado *et al*., 2013; Kumar, 2017). Furthermore, the combination of colours and graphic elements can convey the manufacturer's values, creating a bond with the customer and strengthening the loyalty to the brand.

How the package looks, thus, is an important way to attract customers. Producers can focus on innovation so that when the consumer sees a product with new colours and shape, he/she is attracted to know what it is, or he/she can easily recognise the product they are looking for (Silayoi & Speece, 2004). Additionally, information on the backside helps customers: i) to find information related to the type of product, the raw materials, the plantation and production methods, nutritional facts, expiration date, conservation and use, disposal, ii) to decide, iii) to buy the item if he/she does not find something else more attractive.

Based on these considerations, the packaging is an essential marketing tool to convince customers to buy a product (Rettie & Brewer, 2000) and make a brand, allowing it to stand out against its competitors. The packaging can harness different strategic elements to strengthen visibility and product awareness, such as symbols, colours and labels, influencing customers' attitudes and decision-making and what a brand does (Raghubir & Greenleaf, 2006; Rundh, 2009). Therefore, the packaging is essential in product choice. For this reason, one of the most important goals should be to predict customers' tastes and create specially-made packaging.

What are the essential and most effective graphic elements for customers? We administered a survey to answer this question: which graphic elements in wine packaging influence customers in their decision to buy and the values they associated with colours and labels.

We performed a pilot study based on a face-to-face questionnaire and on a preference ranking experiment in which wine consumers compare three new bottles of Prosecco wine of the same brand. Preference data are analysed using the Rank Ordered Logit model (ROL), a generalisation of the well-known Conditional Logistic Regression (Mc Fadden, 1974) based on the Random Utility theory. This paper illustrates the results of our research and is organised as follows: the first section contains the most important literature about wine packaging; the second one reports the method, describing the survey and the econometric model used to explain which packaging attributes are determinant in customers' choice; the third section contains the sample description and the econometric analysis; in the final section conclusions are drawn.

1. Background

Product purchasing decisions can be characterised by irrational, intuitive, affective and heuristic processes. The buying behaviour of wine is a complex process where the grape variety, brand name, price and region of origin are the most important informational items (extrinsic cues) for consumers used to assess wine products before purchase (Lockshin *et al.*, 2006; Goodman, 2009; Williamson *et al.*, 2016; Thomas & Pickering, 2003; Nunes *et al.*, 2016). Russo & Marin (2016) add awards won in the competitions or assigned by the guides of the sector; also aesthetics or font of the label are among the factors/strategies that allow consumers to understand the complex world of wine by facilitating their approach and appreciation (Boudreaux & Palmer, 2007; Orth & Malkewitz, 2008; Sherman & Tuten, 2011).

The **price** influences the purchase convenience and quality perception; however, its importance changes with the consumer's level of knowledge and information, purchasing power, and involvement (Thach & Olsen, 2015; Russo & Marin, 2016). In purchasing decisions, the price can mainly assume two opposite roles: a positive role and a driver for the choice, when the price is considered a proxy of the quality or prestige of the product; a negative role when it becomes the central element of purchasing choices. In this case, the consumer considers the price too expensive or a disadvantageous quality/price ratio.

For consumer choices, wine **quality** has become a fundamental element, especially in recent years. It is a forced-choice for producers since the recovery of competitiveness on the productivity or production costs side is often limited. This fact has important consequences on marketing since it involves functions/elements aimed at the definition of the wine quality attributes, its communication, identifying the target, and choosing

commercial channels. Quality has an increasingly important role in influencing the strategic and organisational decisions of all the operators participating in the wine production chain. It is transversal to the production process and regards the grape, its transformation, the wine's packaging, up to the consumption stage (Pomarici *et al.*, 2017). It is necessary to underline that the perceived quality is subjective because each consumer elaborates their own expectations on the quality, using the attributes and making purchasing decisions based on needs, situations and values.

Also the **packaging** is an important marketing tool for wineries and attributes like the bottle shape, the glass colour, and label drawing should attract the attention of the potential purchaser (Rocchi & Stefani, 2006; Corduas *et al.*, 2013; Sáenz-Navajas *et al.*, 2013; Kelley *et al.*, 2015; Celhay & Remaudb, 2018). Most consumers will consider the package as a direct reflection of the product's quality (Chaney, 2000). Sáenz-Navajas *et al.* (2013) show an important trade-off in quality perception among different extrinsic cues.

The front label is the first mean of communication to attract the consumer, and it is therefore very important that the characteristics appearing on the label are visually attractive to stand out on the retail shelf. Barber *et al.* (2006) determined that the country of origin in the front label cue is the most important attribute when purchasing wine, followed by the back label cues, the wine style, and the wine description. Other significant attributes are represented by the front label cues of the wine vintage and brand name. As regards bottle packaging, respondents ranked cork seals as an indication of quality. Respondents overall considered bottle closure to be significantly more important compared to bottle shape and colour. The back label has been identified as an under-utilised area for providing information. Furthermore, consumers perceive the back label as one of the primary sources to make a purchasing decision and as a mean of increasing general product knowledge (Charters *et al.*, 1999).

On the contrary, a cross-country comparison of the most important wine choice drivers in the retail sector (Goodman, 2009) showed that having an attractive front label is one of the least important elements consumers consider when choosing a wine.

Boudreaux and Palmer (2007) discovered that the illustration used on the label, colour and layout, had the greatest effect on the American consumers' choice. Warm colours (red, orange) and neutral colours (white, black) positively affected purchase intent. Also, Galati *et al.* (2018), considering Italian red wines sold in the Chinese market, find a significant premium price for label characteristics, particularly for clean and artistic graphic styles. In comparison, a significant price discount has been observed for warm colours. Orth & Malkewitz (2008) examined the associations consumers have with

different holistic packaging designs and found that natural and delicate wine designs were perceived as higher quality, while massive and contrasting designs were associated with being inexpensive.

Laeng *et al.* (2016), using the eye-tracking method during the observation of wine labels, find that consumers prefer wine bottles with label characterised by pictorial elements rather than verbal information.

Another interesting topic is related to fun in the wine label (Lunardo & Rickard, 2019). These authors demonstrate that when consumers face a wine label that incorporates a high degree of fun elements, they perceive the label as less reassuring, leading to decreased perceived quality, and ultimately exhibit lower willingness to pay and purchase intentions.

Consumers' preferences depend on experience, and older frequent wine consumers were influenced most strongly by brand and packaging (Mueller & Szolnoki, 2010), but companies acknowledge that the package is as important as the product to a new generation of consumers. Batt & Dean (2000) noted that modern, innovative and distinctive labels were more attractive to the younger market than the older market, which preferred more traditional styles of packaging.

Some Authors found differences in behaviours and attitudes (Barber *et al.*, 2009; Thach, 2012), indicating that men and women may share different references relative to wine and, therefore, could interpret labels' design differently. Thomas and Pickering (2003) found that colours, images/pictures, and logo used in wine packaging are ranked higher by females as important considerations when deciding on wine purchase. Women have emerged as a new niche market in the wine industry, and wine marketers create products that appeal directly to the female market with such labels as mad housewife and seduction (George, 2005). Barber *et al.* (2006) found that women were not more likely than men to purchase a bottle of wine based on the overall label and bottle packaging or the front label design. However, females found that front label image, picture and logo, and label colours were significant in their decision to purchase a bottle of wine as compared to males. The closure types were significant to the female respondents' choice of wine with wax seals considered an indication of freshness and foil coverings as an indication of quality (Barber *et al.*, 2006).

2. Materials and methods

2.1. *Survey*

Our experiment compared three new bottles of Prosecco wine of the same brand. In particular, we realised some face-to-face interviews based on a

structured questionnaire with the PAPI (Paper Assisted Personal Interview) system to compare three different packagings of a Prosecco wine bottle and understand why people prefer one over another.

The interviews were conducted from 9 am to 7 pm on Tuesday in two supermarkets in two different cities in Northern Italy: in the suburb of Padua and the centre of Milan. We decided to use two cities because of their different kinds of customers and of their relation with Prosecco wine: in Padua, Prosecco wine is extremely popular and people use it more often than in other cities around Italy; in Milan, Prosecco wine is well-known, but customers perceive it more as appropriate for parties or events and recognise it more as a niche product.

To be eligible, the interviewees must be regular wine drinkers (that is, drink wine at least once a week) and are in charge of wine purchase in the household. We administered about 100 interviews in each supermarket, with just over 200 customers involved in total. The sample selection was based on socio-demographic characteristics, such as gender, age, educational qualification, wine consumption and purchase, to adhere to pre-defined gender and age quota. The distribution of people who drink wine at least once a week and are household buyers is unknown. However, we know that men and older people mainly drink wine, while female and more mature persons are buyers in the household (Table 1). Hence the unknown joint distribution should seem to demographic distribution by gender and age groups, but older persons weight more than youngers. For these reasons, our sample starts from 25-year-old and slightly oversamples older groups compared to the general population demographic distribution. Despite being based on quota, our sample should be described as a "convenience sample" selected by a "mall intercept" method; thus, selection bias is very likely. Therefore, the results of this study cannot be used to make inference on the population.

During the interviews, we showed the respondents three different bottles of the same wine and brand with different packaging (Figure 1) that they had never seen before and asked customers to rank them starting from the favourite one. Then we asked them to say, on a four-point Likert scale (unimportant, slightly important, quite important, very important), the importance of some characteristics of the packaging in their choice: Label's form, Label's colours, the Label in its entirety, the Writing "Prosecco", the Band on the bottle's neck and the Bottle's shape. In this way, we can explore the main motivations which drove interviewees to choose a particular bottle.

Table 1 - Socio-demographics distribution by gender and age groups (per cent)

Age	Wine consumers		Household Buyers		Target demographics		Actual sample	
	Female	Male	Female	Male	Female	Male	Female	Male
25-44	17,9	29,4	26,6	14,9	24,6	24,1	24,6	21,2
45-64	20,1	32,7	35,9	22,6	27,1	24,3	31,8	22,4

Source: our elaborations on Istat data ('Aspetti della vita quotidiana' and demographic statistics).

Figure 1 - Three shown bottles

2.2. *Rank-ordered logit model*

As well point out by Le *et al.* (2020), empirical studies on consumers' preference often rely on survey data, in which respondents are asked to indicate their preference over a set of choices. Generally, in such surveys, the respondents show the most preferred choice. This setting will lead to a logit/probit model if there are only two choices in the choice set and a multinomial logit (MNL)/multinomial probit (MNP) model if the choice set contains more than two choices. Instead, in our setup, respondents are asked to rank the whole choice set from the most preferred to the least preferred. Then, the data is said to be in the form of rank-ordered data. In this case, the rank-ordered logit ("ROL") model must be used, which contains more

information about respondents' preference compared to the traditional logit/probit data.

ROL is not widely used, perhaps due to the complexity of the underlying consumer choice process based on asking individuals to rank rather than rate a set of items according to some criteria. Concerning agri-food sector studies, this model was used in a few cases. In particular, Myung *et al.* (2008) used the ROL model to understanding attributes that contribute to consumer meal choice decisions within a *prix fixe* menu. The study respondents were given four pre-selected meal choice combinations (bundles) and asked to rank these given meal choice options in order of preference. A more recent study (Øvrum *et al.*, 2012) considered this model for a choice experiment on semi-hard cheese from Norway to estimate the effect of health information on diet choices. Costanigro *et al.* (2014) investigated perceptions on sulfites and willingness to pay for no-sulfite wines based on a rank-ordered logit estimation of best-worst choices. Another interesting paper based on ROL was proposed by Le *et al.* (2020); these authors empirically investigated the role of indicators and cues considered by consumers when purchasing safe vegetables. Canavari *et al.* (2018) used this model to investigate Italian consumer preferences for dry-aged pork loin and other relevant meat attributes and to evaluate the effect of information on consumer preferences.

In the economic literature, ROL was proposed by Beggs *et al.* (1981) and further developed by Hausman and Ruud (1987). The model was independently formulated by marketing researchers (Punj & Staelin, 1978; Chapman & Staelin, 1982) who called it "Exploded logit model" because the model coefficients are estimated using data in long shape which sample size is N*J, where N and J are respectively the number of respondents and the dimension of the choice set.

ROL generalises the well-known Conditional Logistic (CL) model (Mc Fadden, 1974) and is based on the Random Utility theory.

The main difference between ROL and CL (Conditional Logit model) is that the latter deals with choosing one option among unordered alternatives, while the former deals with an individual's ranking set of options. Schematically, the ROL model assumes that the respondent performs the ranking as follows: at the first step, 1 item (respondent's favourite) is chosen from the full set of options available and ranked first; then, the next favourite from the remaining items is chosen and ranked second, and so on; the item selection continues until some limit, fixed a priori, is reached.

Let U_{ij} the utility function of the individual i for the alternative $j = 1, 2, \ldots J$, where J represents the number of all the different and exclusive alternatives.

According to the RUM - Random Utility Model (Luce, 1959; McFadden, 1974; Allison Christakis, 1994), the individual's utility U_{ij} is the sum of a systematic component μ_{ij} and a random component ϵ_{ij}:

$$U_{ij} = \mu_{ij} + \epsilon_{ij}$$

μ_{ij} is the so-called deterministic component and reflects the population's representative tastes, while ϵ_{ij} is the stochastic component and represents the idiosyncrasies of the individual i for the alternative j.

The functional form of the deterministic part of the Utility function is a linear specification:

$$\mu_{ij} = \beta_j x_i + \gamma z_i + \theta w_{ij}$$

where: x_i is a column vector of variables that describe respondents but do not vary across different items with a generic coefficient β_j; z_i is a column vector of variables that vary across the attributes but are the same for all respondents with a specific coefficients γ; w_{ij} is a column vector of variables describing a relationship among the items and the respondent with specific coefficient θ.

If $\theta = \gamma = 0$, the ROL collapses to a Multinomial Logit model, while if $\theta = 0$ and β and $\gamma \neq 0$, ROL collapses to the McFadden's Conditional Logistic model.

The respondent i will give a better rank to alternative m than alternative j if $U_{im} > U_{ij}$.

Formally[1]:

$$U_m - U_j = (\mu_m - \mu_j) + (\epsilon_m - \epsilon_j) > 0$$

Alternative m will be ranked as the most preferred among the full choice set, if and only if, for $\forall\ m \neq j$, $U_m > U_j$, so that we have the following J-1 equations:

$$\begin{gathered} U_m - U_1 = (\mu_m - \mu_1) + (\epsilon_m - \epsilon_1) > 0 \\ U_m - U_2 = (\mu_m - \mu_2) + (\epsilon_m - \epsilon_2) > 0 \\ \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ U_m - U_J = (\mu_m - \mu_J) + (\epsilon_m - \epsilon_J) > 0 \end{gathered}$$

Alternatively, the $J - 1$ conditions can be rewritten in the following manner:

1. For sake of simplicity we'll omit the individual index.

$$\epsilon_1 < (\mu_m - \mu_1) + \epsilon_m$$
$$\epsilon_2 < (\mu_m - \mu_2) + \epsilon_m$$
$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$
$$\epsilon_J < (\mu_m - \mu_J) + \epsilon_m$$

So we can define the probability of choosing alternative m as the Cumulative Probability Function of $J - 1$ error terms:

$$P(m \mid \epsilon_m) = P(U_m > U_1, \ldots U_m > U_J)$$

If we assume for the error terms Independence, Gumbel distribution and Identical distribution, it is possible to show that the probabilities have very simple, closed forms, which correspond to the logit transformation of the deterministic part of the utility (McFadden, 1974).

If we assume that the most preferred is item $j = 1$, the probability can be written in the multinomial logit form:

$$P(1 \mid \epsilon_1) = \frac{\exp(\mu_1)}{\exp(\mu_1) + \exp(\mu_2) + \ldots + \exp(\mu_J)}$$

The coefficients of the ROL are estimated using maximum likelihood.

More generally, we can define the following likelihood for the single respondent i (Allison and Christakis, 1994):

$$L_i = \prod_{j=1}^{J} \frac{\exp(\mu_{ij})}{\sum_{k=1}^{J} \delta_{ijk} \exp(\mu_{ik})}$$

where $\delta_{ijk} = 1$ if $U_{ik} > U_{ij}$ and 0 otherwise.

For a sample of n respondents, the log-likelihood is given from the following formula:

$$logL = \sum_{i=1}^{n} \sum_{j=1}^{J_i} \mu_{ij} - \sum_{i=1}^{n} \sum_{j=1}^{J_i} log \left[\sum_{k=1}^{J_i} \delta_{ijk} \exp(\mu_{ik}) \right]$$

One of the β_j must be set equal to 0 to achieve identification. The choice of the reference item is arbitrary (Allison & Christakis, 1994). Coefficients represent marginal utilities, which are not interpretable because the utility is ordinal. However, ratios of coefficients are marginal rates of substitution, which are interpretable. They express the direction and weight of the

attributes. Thus β_{kj} is the effect of x_k (*k-th* variable) on the log odds of choosing alternative *j* over the base category. If $\beta_{kj} > 0$, increasing the *k-th* variable, the respondent assigns a higher utility to item *j* than the reference item.

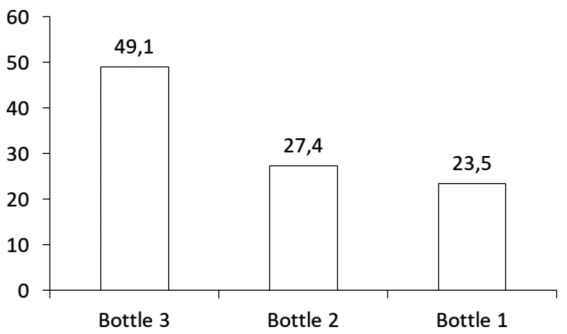
3. Results and discussion

3.1. *Sample characteristics*

The explorative analysis (Annex 1) shows that the sample is composed of women (56.4%), mainly aged over 55 (36.3%), followed by 35-44-year-old (22.9%) together with 25-34 (22.9%) and in the end 45-54 group (17.9%). Concerning the educational level, 44.1% holds a secondary school diploma, while 40.8% holds a bachelors degree. In detail, 26.3% consumes wine every day and 36.9% more than once a week, but only 28.5% drinks Prosecco wine during meals. Most interviewees drink Prosecco wine as an aperitif (54.2%) or during parties (63.1%, total exceed 100% because the habit of consuming Prosecco wine is a multi-response question: people could use Prosecco wine in different ways): 86.6% bought a bottle of wine in the last month; 55.3% bought a bottle of Prosecco wine in the same period; 38.9% spends less than five euros when buying Prosecco wine at super/hypermarket and 31.8% between five and six euros. Finally, the main reason to buy Prosecco wine is as a present or to use it on special occasions (71.5%).

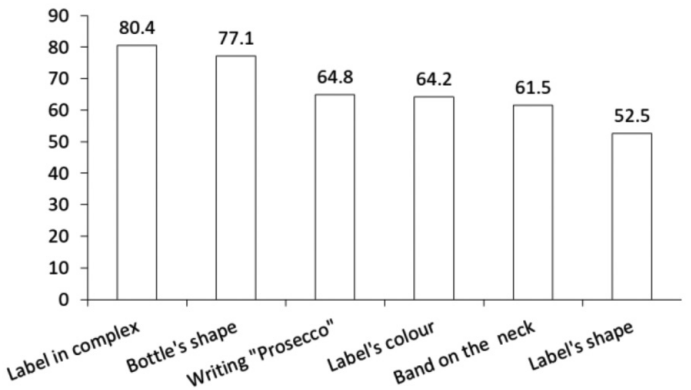
Almost half of the involved customers concentrated their choice on bottle number three (49.1%, Figure 2). The other two received about one-quarter of the preferences (23.5% the first one and 27.4% the second).

Figure 2 - Frequencies (%) of bottles rated first place



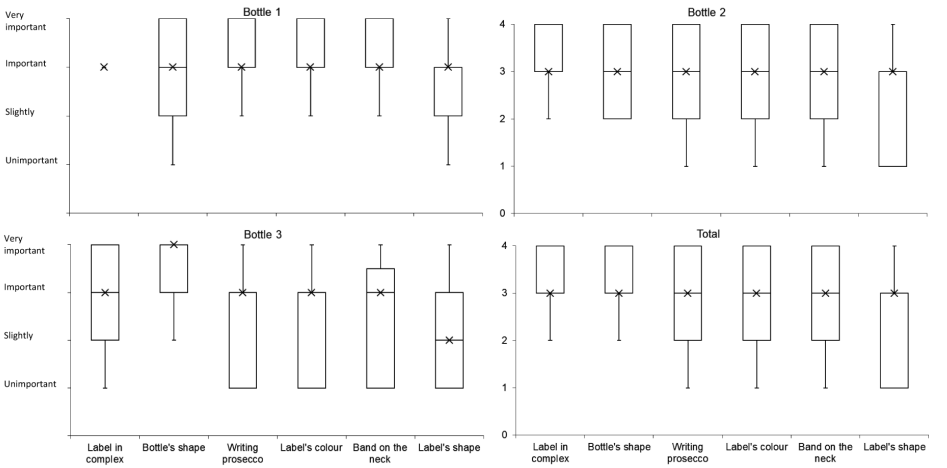
They chose the number three, whose packaging was perceived as more innovative and modern, with a different bottle's shape. Indeed 77.1% of respondents tend to consider quite or very important Bottle's shape, and in particular, the share increases to 88.9% for bottle number three (Figure 3). Band on the neck, Writing "Prosecco" and Label's colour are important (over 60% points out them as quite or very important attributes), but they are not crucial in the choice. Almost 50% reveals Label's shape as not at all or slightly important. Finally, overall, Label is quite or very important for 80.4% of interviewed customers. However, as we will see below, this attribute is not really able to determine the bottle's choice.

Figure 3 - Percentage of respondents who rated attribute quite or very important



Since the attributes drive the choice, we derive the importance of bottle attributes depending on which bottle has been chosen (Figure 4). Those who preferred bottle 1 assessed the Writing "Prosecco", Band on the neck and Label's colour with a higher rating. For bottle 3, Bottle's shape was the most significant element. For people who chose bottle 2, almost all attributes are important, except for the Label's shape, which is less important also for bottle 1 and 3. Figure 4 explains why the overall Label characteristics cannot forecast the chosen bottle: almost everybody rated this attribute as important.

Figure 4 - Box plot of bottle attributes rating by the preferred bottle



3.2. *Model estimation*

The variables considered in the estimated ROL model are gender, age, education level, frequency of wine and Prosecco wine consumption, frequency of wine purchase, the reason for buying Prosecco wine and its reference price. Moreover, we consider the choice motivation and transformed the four-point Likert scale into a dichotomic variable, where 1 indicates the bottle attribute is quite or very important in the customer preferences, and 0 indicates the attribute is slightly or not at all important (Annex 2).

As stated above, in order to achieve identification, we set bottle 1 as the reference alternative. We considered different model formulations, and in the final one (Table 2) we included only variables significant at least at the 10% level. Since the ROL model belongs to the logit model class, estimates can be interpreted in terms of odds-ratio by exponentiating the coefficients. Thus, the coefficients indicate the percentage change in the odds of ranking a particular alternative compared to bottle 1 for a unit change in an explanatory variable. In this formulation, constants are not statistically significant. So we can state that no difference is perceived between bottle two and three by the interviewee after we have controlled for socio-demographic and preference variables.

Considering the effect of covariates on the probability of choosing a particular bottle, all else being equal, all attributes are not significant for bottle 2, while for bottle 3 they are all significant: the more relevant result is related to the bottle's shape. Indeed, the Bottle's shape being quite or very

important increases the odds of preferring bottle 3 over bottle 1 by 257%. Considering the Label's colour quite or very important, instead, decreases the odds of preferring bottle 3 by 46%; the "Prosecco" writing decreases the odds of choosing bottle 3 by about 70%, while looking at the Band on the neck as a quite or very important element diminishes by about 60% the odds of preferring bottle three. Label in complex results not significant in the estimated regression since the respondents assigned almost equal importance to this attribute (Figure 4).

Once we have controlled the bottles' element heterogeneity, we see that socio-demographic variables also affect preferences. Tertiary education, age over 55, drinking wine every day, and drinking Prosecco wine as an aperitif, all increase the odds of bottle 3, pointing out some heterogeneity in the customers' value function, which probably applies different decision weights. To test whether socio-demographic variables affected the preferences, we included interactions between the bottle's attribute importance and respondents' characteristics. We tried many specifications of the model with different kinds of interaction. The most reliable formulation is proposed in Table 3, where only the Band on the neck and Writing "Prosecco" are allowed to vary over socio-demographic characteristics.

In terms of goodness of fit (Table 4), the two models are very similar. The Log-likelihood differ only for one point, and the log-likelihood ratio (LR test) is statistically significant in both cases (the chi-square statistic p-value < = 0.05, indicates the estimated model improves the fit to the data significantly). It is impossible to compute the R^2 statistic for the ROL model, but the so-called pseudo R^2 (Cox & Snell, 1989) surrogates it. Both models clearly improve the proportion of explained variance in the dependent variables compared to the model with constants-only, but the second model shows a slightly higher pseudo R^2. The full model correctly predicts 54,6% of cases, while the first model 53,3% and the model with the two constants less than 52%. In terms of the Akaike information criteria (AIC), the first formulation have the minimum AIC: it has almost the same log-likelihood level, but it is the most parsimonious.

Reading Table 3 (in this specification with interaction), the parameter estimates are very similar to those obtained from the previous model: constants are not significant, bottle's attributes are significant only for the third bottle and respondents characteristics are no longer significant. Moreover, the interacted coefficients are significant with p-values less than 0.10: this means that the valuation of weights of the bottle's attributes is not constant by categories of customers' socio-demographic characteristics. In other words, the coefficients vary between different groups of

respondents[2]. In particular, for bottle 2, all but one interacted coefficients were not statistically significant at the 0.1 level: only graduated and non-graduated respondents differ in their preferences for Writing "Prosecco" (it is worthwhile to underline that the two groups have the same bottle preferences: Tertiary education coefficient is not significant). Instead, for bottle 3, interacted coefficients are all significant at the 0.1 level, except in one case. Indeed, in this case, graduate and non-graduated customers' preferences for Writing "Prosecco" are no longer different. Instead, customers who drink Prosecco as aperitif show different preferences for Writing "Prosecco". Moreover, the 55+ year-old perceive Band on the neck differently from younger people; this attribute is also seen dissimilarly based on the frequency of Prosecco consumption.

It is easier to read the results of Tables 3 in terms of bottle preference. Bottle 2 is statistically identical to bottle 1. There is a marginal difference about Writing "Prosecco": non-graduated customers prefer the writing of bottle 1, while for graduated ones, they are quite indifferent. On the contrary, bottle 3 is different from bottle 1: customers prefer Label's colour of bottle 1, but they choose the shape of bottle 3; Writing "Prosecco" decreases the probability of selecting bottle 3, but less for people who drink Prosecco as an aperitif; finally, also Band on the neck diminish the probability of taking bottle 3, but for customers aged over 55 or who drink wine every day, Band on the neck is not important.

Table 2 - Attributes effects on Respondents' preferences

Variable	**Bottle 2**				**Bottle 3**			
	Coef.	**Odds**	**%**	**Sig.**	**Coef.**	**Odds**	**%**	**Sig.**
Constant	–0.068	0.934	–6.6		0.460	1.583	58.3	
Label's colour	–0.206	0.814	–18.6		–0.617	0.540	–46.0	*
Writing "Prosecco"	–0.510	0.600	–39.9		–1.163	0.313	–68.7	**
Band on the neck	–0.122	0.885	–11.5		–0.907	0.403	–59.6	**
Bottle's shape	0.561	1.753	75.3		1.273	3.571	257.0	**
55+ year old	0.407	1.502	50.2		0.906	2.474	147.4	**
Tertiary education	0.648	1.912	91.2	*	0.649	1.9123	91.3	*
Drinks wine every day	0.794	2.212	121.2	*	0.891	2.439	143.9	**
Drinks Prosecco as an aperitif	0.360	1.434	43.4		0.664	1.942	94.2	**

Note: *p-value < 0.1; **p-value < 0.05

2. In order to present clearer results interacted coefficients are not differential but they are combined with socio-demographic characteristics.

Table 3 - Attributes effects on Respondents' preferences – model with interaction

Variable	Bottle 2				Bottle 3			
	Coef.	Odds	%	Sig.	Coef.	Odds	%	Sig.
Constant	0.321	1.378	37.8		0.856	2.355	135.5	
Label's colour	–0.226	0.798	–20.2		–0.626	0.535	–46.5	*
Writing "Prosecco"	–0.939	0.391	–60.9		–1.603	0.201	–79.9	**
Band on the neck	–0.185	0.831	–16.9		–0.975	0.378	–62.2	**
Bottle's shape	0.543	1.721	72.1		1.256	3.511	251.1	**
Writing "Prosecco" - Tertiary education	0.669	1.953	95.2	*	0.618	1.856	85.6	
Writing "Prosecco" - Drink Prosecco as aperitif	0.551	1.734	73.4		0.881	2.412	141.2	**
Band on the neck - 55+ year old	0.525	1.690	69.0		0.984	2.677	167.7	**
Band on the neck - Drink wine every day	0.770	2.161	116.1		0.928	2.530	153.0	*
55+	0.261	1.298	29.8		0.848	2.335	133.6	
Tertiary education	0.572	1.771	77.1		0.631	1.880	88.0	
Drink wine every day	0.806	2.238	123.8		0.777	2.176	117.6	
Drink Prosecco as aperitif	–0.102	0.903	–9.7		0.151	1.164	16.4	

Table 4 - Goodness of fit values for three rank-ordered logit models

Model	Log Likelihood	LR	df	Pseudo R^2	% of correct rank	AIC
Two constants (second and third bottle)	–304,921	31,607	2	0,049	51,955	613,843
First	–272,243	96,960	18	0,151	53,259	580,486
Second (with interaction)	–271,530	98,389	26	0,153	54,562	595,061

4. Discussion and conclusions

With this study, we investigated the preferences for attributes of three bottles of Prosecco wine, which consumers had never seen before, through the ROL model.

As well documented in the literature, age affects decisions: younger market prefers modern, innovative and distinctive packaging (Batt & Dean, 2000), while in this research, we find older persons are likely to choose newer bottle's shape. Moreover, results suggest gender does not affect decisions, while education, experience and habit strongly influence preferences towards newer bottle's shape. This result confirms Mueller & Szolnoki (2010) findings, showing how consumers' preferences depend on experience and that frequent wine consumers were influenced by packaging. Also, Corduas *et al*. (2013) signal that packaging (label and bottle shape) and brand name are of little importance for Italian consumers. The positive effect for such attributes increases in case of daily consumption since everyday wine is mostly considered as a 'simple' beverage. This aspect also relates to brand recognition in a market where costumers are overwhelmed by too many choices. Where the sector's fragmentation complicates the sales process, the label is not only used as a tool to give information, but its design, associated with the aspect of the bottle and seal, make the product visually distinctive, standing out on the shelves, and attractive to potential purchasers.

Results from rank-ordered logit analysis show that reference price was considered not important. Consumers not always like more innovative packaging: in this research, a newer bottle's shape is appealing, but a more traditional bottle's neck or a bright label or a bigger and more elegant Writing "Prosecco" are preferred. This result confirms Celhay and Trinquecoste (2008) finding that French consumers, whether young or old, novice or expert, still prefer wine with traditional labels to reduce perceived risk. Allowing for preference heterogeneity, the estimated measures of the importance of each bottle attributes, relative to attributes of reference bottle, in determining consumer preferences are very similar to those obtained from the former model, where all respondents are assumed to use the same preference pattern. Bottle 2 is statistically identical to bottle 1, while bottle 3's shape contributed to the largest percentage of consumers' preference rating (251.1%). The Band on the neck and the Writing "Prosecco" diminish the probability of choosing bottle 3 by 62.2% and 79.9%, respectively. Also, the label's colour of bottle 3 decrease its utility (-46,5%), but it is marginally significant.

The results from the regression model with interaction between socio-demographic variables and bottle's attributes indicate that customers do not apply the same decision weights: for interviewees aged over 55 or who drink wine every day, the Band on the neck does not seem to be important, while for other groups the Band on the neck diminishes the utility of bottle 3. Writing "Prosecco" decreases the probability of selecting bottle 3, too, but for consumers who drink Prosecco as an aperitif, the reduction is less strong.

These findings suggest that it is difficult to please all customers through only one packaging. For this reason, survey research like the present one can be useful to reduce the risk of failure and assess customer preferences before launching a new packaging.

This work also provides some managerial implications. In the past, the role of packaging and labelling was exclusively related to protecting the product and providing information; more recently, they have taken on an important role in marketing communication and the decision-making process. Therefore, many wineries have recognised the importance of having good packaging to differentiate the offered products (Rundh, 2009) and reduce information asymmetry. This study could help managers and wine label designers identify the most relevant packaging's attributes for consumers and address the label design and colour, the bottle's shape and neck consistently with the target market segment.

This pilot study was based on a convenience sampling procedure, prone to self-selection, then it has limitations in terms of representativeness and the possibility of generalising the results. An additional wave of data collection based on a sample that better fits the population of interest's social characteristics would be necessary to validate the results.

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Annex 1 - *Sample composition (percentage frequencies)*

Characteristics	%	Variables	%
Gender		Main reason to buy Prosecco	
Female	56,4	For present or during special occasions	71,5
Male	43,6	Usual consumption	28,5
Age		Bought a bottle of wine	
25-34	22,9	In the last month	86,6
35-44	22,9	Over a month ago	13,4
45-54	17,9	Bought a bottle of Prosecco	
55+	36,3	In the last month	55,3
Education		Over a month ago	44,7
Less secondary		Drink wine	
Secondary	15,1	Every day	26,3
Bachelors	44,1	More than once a week	36,9
When buying Prosecco at super/iper market spends	40,8	Once a week	36,8
Less than 5 euros	38,9	Drink Prosecco*	
5-6 euros	31,8	During parties	63,1
6+ euros	29,3	As aperitif	54,2
		During meal	28,5

Note: * Multi-response question.

Annex 2 - *Description of variables*

Variable	Description	Kind of variable
Label's colour	Importance of label's colour in their choice	Dummy: 0 = slightly or not at all important; 1 = quite or very important
Writing "Prosecco"	Importance of writing "Prosecco" in their choice	Dummy: 0 = slightly or not at all important; 1 = quite or very important
Band on the neck	Importance of label's colour in their choice	Dummy: 0 = slightly or not at all important; 1 = quite or very important
Bottle's shape	Importance of bottle's shape in their choice	Dummy: 0 = slightly or not at all important; 1 = quite or very important
55-70 year old	Age group	Dummy: 0 = age25-54; 1 = age 55-70
Tertiary education	Education level	Dummy: 0 = compulsory or secondary school; 1 = graduated
Drink wine every day	How many times drink wine per week	Dummy: 0 = drink wine once or more a week; 1 = drink wine every day
Drink Prosecco as aperitif	When drink Prosecco	Dummy: 0 = drink Prosecco during meal or parties; 1 = drink Prosecco as aperitif

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Economia agro-alimentare /
Food Economy

An International Journal on Agricultural and Food Systems

Vol. 23, Iss. 1, Art. 3, pp. 1-24 - ISSN 1126-1668 - ISSNe 1972-4802
DOI: 10.3280/ecag1-2021oa11547

Are small and medium-size food industry firms profitable? Explaining differences in their performance: The case of the Valencia Region

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Abstract

The main aim of this study was to determine the factors that influenced profitability of companies involved in the Valencia food industry between 2006 and 2015. For this, macro-economic, sector and company variables were the key elements used in the statistical analysis, together with their dependence on the economic cycle in indicating the present state of the sector in the Valencia Region. The panel data was obtained from the SABI data base and combined with transverse data and time series. Economic and financial profitability are both influenced by certain common factors, especially the sales margin. The higher the margin the higher the profit, although this relationship also depends on where the business company is located. Rotation of assets also contributes to raising profits in times of economic expansion. The Economic Crisis saw profits fall in 2009 and 2012, two of its worst years. Finally, differences were also found between large and small enterprises.

Article info

Type:
Article
Submitted:
20/08/2020
Accepted:
18/02/2021
Available online:
31/05/2021

JEL codes:
D23, M21, Q13

Keywords:
Food industry
Sales margin
Assests rotation
Firm size
Economic crisis

Managing Editor:
Stefanella Stranieri

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Introduction

The food chain is one of Spain's most important economic sectors. Despite its importance, previous studies that analyze company profits drivers mainly focus on whole economies or entire manufacturing sectors, while the evidence on regional food firms is still scarce. Nevertheless, the new regional urban economics and economic geography research (Brakman *et al.*, 2009; Duranton *et al.*, 2015) have pointed out the importance of intra-regional differences for profitability (Tamminen, 2016). This question especially attracts our interest to the Valencia Region (see Map 1), where the food industry has established itself at the top of the sector as a powerful source of job creation, employing 14% of the population[1], whose survival depends on the companies' ability to make a profit. This paper addresses the following gap research: what are the key business attributes that can explain the differences in performance between food companies within the Valencia Region?

Our data extend the empirical evidence on the regional determinants of profitability. We focused on the explanatory macroeconomic, sector and entrepreneurial factors that influence profitability. The first of these has to do with the general economic framework in which the firms operate, which are common to all the businesses in the same economic region and equally affect all the companies in a certain area. The second is related to the business activity's different organizational structures and technological conditions and influence both the business strategies and the results. The third is linked to the company's intrinsic characteristics, such as size, the available resources, and its capacity for indebtedness, fundamental variables in explaining firm profitability (Zouaghi *et al.*, 2017).

1. The largest sub-sectors in the food industry in Valencia, according to data from 2015, were in order of importance: the meat industry, fruit and vegetable preserves, bread, cakes and flour products (these four representing 57% of the turnover). As regards their relative weight in the national total, the most significant commodities were flour products (25.6%) and preserved fruit and vegetables (17.9%). In overall terms, food industry in Valencia Region, with a total turnover of €9,400 m, made up 8.6% of total sales sector in Spain. As regards added value, the GAV of the food, drinks and tobacco industry in Valencia represented 9.1% of the Spanish total for this industry in 2015, similar its percentage contribution to the total GDP. Comparing the productivity (GAV/worker) of the Valencia food industry with the Spanish figure, we get a ratio of 60.3/55.7. This higher productivity is found basically in fruit and vegetable preserves, flour products, mineral water and alcoholic drinks, and fish products. According to the latest figures from the Valencia Statistics Institute, the food industry represents approximately 9.4% in GDP of Valencian economy, 11% of the total enterprises in the Community of Valencia, employs 14% of the working population (more than 34,000 people employed) and comprises 14% of total net sales (Grupo Cooperativo Cajamar, 2017).

Map 1 - Valencia Region in Spain

The classical theory of industrial organization or Industrial Economics assumes that the industry's characteristics that determine the scope of entry barriers and competition are the main determinants of a company's performance (Wedge & Al-Laham, 2008). The literature on strategic management, particularly the Theory of Resources and Capabilities, emphasizes the importance of the specific resources of the company as determinants of profitability, so that differences in company performance arise due to differences in the endowment of these resources, which include tangible production factors, i.e. financial and physical, and intangible factors such as technology and reputation (Claver *et al.*, 2002; Goddard *et al.*, 2005). The divergence between these two schools of thought lies in whether the industry effect or the company effect plays the main role in explaining a company's results. While Industrial Economics highlights the importance of industrial factors in business performance, the Theory of Resources and Capacities maintains that an organization's internal resources and capacities are the main factors that determine variations in the results. Inspired by Schmalensee (1985), the joint consideration of both the structure of the sector and corporate resources as the determining factors of business results has led to the development of one of the main lines of research in terms of profitability.

Regarding the bibliographic background on profitability in the food industry, the works of Schumacher and Boland (2005a, 2005b) and Chaddad

& Mondelli (2013) are outstanding examples regarding the U.S. food industry. Using variance decomposition methods, Schumacher and Boland showed that the industry effect is more important than the company effect. However, Chaddad & Mondelli applied a hierarchical linear model to determine the impact of both effects, finding that the company effect exceeds the industry effect and that variables such as the intensity of corporate R&D and industry capital were the main drivers of company earnings.

In this framework, important studies on the European food industry include the works of Hirsch & Gschwandtner (2013) and Hirsch & Hartmann (2014). The former implemented a panel model showing that persistence of profits in the E.U. food industry is significantly lower than other manufacturing sectors and identified company size as the main driver of profits. For their part, using a hierarchical linear model, Hirsch & Hartmann provided evidence of company size and industry concentration as the dominant drivers of profitability. Analyzing both the U.S. and the E.U., Gschwandtner & Hirsch (2018) through the dynamic panel estimator confirmed that the persistence of profits in food processing is lower than in other manufacturing sectors and that the specific drivers of company profitability are the size and financial risk, followed by certain characteristics of the industry such as its rate of concentration and growth.

As regards the Spanish case, Schmalensee's school of thought (1985) has been followed by authors such as Claver *et al.* (2002), Pereira *et al.* (2011), Alarcón & Sánchez (2013) and Zouaghi *et al.* (2017), among others. According to the region studied, these research groups used different data sources, the objective of the study and the preference of the analysts, although most of the data were extracted from the companies' annual accounts and mercantile registers. Among the most frequently used databases are the Spanish Balance Analysis System (SABI in Spanish), the Vigo Custom-Free Consortium database, The Bank of Spain's Central Balances, and the Ministry of Industry's Survey of Business Strategies. The Principal Component Analysis, panel estimator approaches, and hierarchical linear modelling or ANOVA were the main statistical methods. These studies concluded that the company effect had a stronger influence on profitability than the industrial effect. Grau & Reig (2015) showed the effect of the Great Recession on business performance.

Most of the studies cited consider entire economies or are restricted to companies operating in specific countries' manufacturing sectors. In other words, there are still few studies that address the local perspective. Therefore, the purpose of this work was to provide evidence of intra-regional differences for profitability, following the line of previous work on the subject in the E.U. to measure the factors involved in profitability. The common aspects of these studies are obtaining panel data and measuring fixed-effect

models (Kocisova, 2014; Capasso *et al.*, 2015; Abulescu *et al.*, 2016), or by combining different explanatory variables (Amadieu & Viviani, 2010; Soboh *et al.*, 2011; Notta & Vlachvei, 2014; Voulgaris *et al.*, 2014).

In this context, this study aimed to evaluate the factors that determine profitability in the Valencia food industry in the period from 2006 to 2015, with the following specific objectives:

1. Identify the main components of economic and financial profitability; variables such as years, economic cycle, net turnover, operating profits, number of employees, sub-sector, location, legal characteristics, external commerce, and yearly results, among others, have been considered to explain differences in the evolution of profitability.
2. Use multivariate methods on panel data to estimate the factors that determine the companies' economic and financial profitability in the Valencia food industry and their importance in the years 2006 and 2015.

One of this paper's main contributions is that it verifies the health of a strategic sector of the Valencian industry, vital for its economic development, and provides a deeper vision of the most influential attributes in individual companies' performance at the local level (i.e., within the region). It also proposes a method of collecting and analyzing business data, repeatable in time and space, thus constituting a solid and reliable source of business information that can be used to estimate and track Spanish local, regional, and national results.

The remainder of the paper is organized as follows. Section 1 summarizes the meta-sample construction and research method used and presents the meta-sample's key descriptive statistics. Section 2 gives the regression model and sensitivity tests results, while Section 3 discusses the key implications of our findings and our conclusions.

1. Materials and methods

Company data are drawn from the SABI balance sheet database, generated by Bureau van Dijk. Initially, all the active firms operating in processing food and drinks in Valencia with observations available during the period 2006 to 2015[2] were selected (428 companies). After removing extreme and inconsistent values, a total of 414 actives companies made up the sample. The commonly

2. The 10-year period between 2006 and 2015 was selected because it includes expansive and recessive cycles of the Spanish economy, representing the Great Recession as well as the years before and after. It was not possible to incorporate annual accounts for 2016 because when the data was collected, some companies had not registered them in the Mercantile Registry.

used dependent variables chosen to explain the results were as follows (Hirsch & Hartmann, 2014; Gaganis *et al*., 2015; Zouaghi *et al*. 2017)[3]:

- **Economic Profitability or Return on Assets (ROA)**: dependent variable calculated as pre-tax profits divided by total assets, expressed as a decimal.
- **Financial profitability or Return on Equity (ROE)**: dependent variable calculated as net profits divided by capital, expressed as a decimal.

Most previous research on firm profitability has focused on the industry- and firm-specific factors (Goddart *et al*., 2005; Grant & Nippa, 2006; Chaddad & Mondelli, 2013; Hirch & Hartmann, 2014). The explanatory variables that can influence profitability were thus selected from the Industrial Economy, and Theory of Resources and Capacities perspective (the descriptive statistics of the quantitative variables are shown in Table 1), including company size, market share, growth, age, or financial risk were identified as specific determinants (Yurtoglu, 2004; Chaddad & Mondelli, 2013):

- Corporate characteristics such as net turnover (NT), number of employees (NE) and total assets (TA), (representing company size according to E.U. company size classification recommended in 96/280/CE), earnings before taxes (EBT), earnings before interest and taxes (EBIT), profits before interest, taxes, depreciation and amortization (EBITDA), net profits (NP), own capital or net wealth (OC), financial leverage (FL), rotation of assets (RASS), sales margin (SMAR), fiscal effect (FE), legal standing (LS, a qualitative variable that takes the value of 1 in case of a joint-stock company and 0 if limited company), and exporting activity (EXP).
- The effect of macroeconomic fluctuations can be incorporated by means of year effects. Macroeconomic factors evaluate how far the financial crisis impacted agri-food firm profitability. They are described by a qualitative variable (YEAR) that takes the value of 1 in an expanding economy and 0 in a recession[4].
- The location or territorial effect is contained in two qualitative variables (CAS and AL) that distinguish between Valencia, Castellón and Alicante.
- The sector effect, by 8 qualitative variables (SUB10X), distinguishes between the nine subsectors involved in the Valencia food industry, according to the National Economic Activity Classification (NEAC)[5].

3. Gschwandtner & Hirsch (2018) offer a critical discussion of its use in profitability measurement.

4. Economic cycles, initially expressed in quarters, are in growth or recession if GDP rises or falls during two consecutive quarters, are given in years since the econometric model is based on annual periods. Real GDP was used as the reference to determine rises and falls in the value of production allowing for inflation.

5.According to the NEAC, the subsectors of the Valencia food industry are as follows: 101. Meat processing and meat products; 102. Fish and seafood preserves; 103. Processed and preserved fruit and vegetables; 104. Vegetable oils and animal fats; 105. Milk products; 106. Cereals and starch products; 107. Bread and pasta; 108. Other food products; 109. Animal feeds.

Table 1 - Descriptive statistics

Variable	Definition	Mean	S. Deviation
Dependent variables			
ROA	**Economic Profitability o Return on Assets**: variable calculated as pre-tax profits divided by total assets, expressed as a decimal	0.038	0.103
ROE	**Financial Profitability o Return on Equity**: variable calculated as net profits divided by own capital, expressed as a decimal	0.035	0.222
Explanatory variables			
Firm-level			
NT	Net turnover	5558255	13400000
NE	Number of employees	28.27	58.02
TA	Total assets	4020692	9481670
EBT	Earnings before taxes	295675.7	1160321
EBIT	Earnings before interest and taxes	330652.5	1164356
EBITDA	Earnings befere interest, taxes, depreciation and amortization	516933,4	1691015
NP	Net profits	211618.8	782243
OC	Own capital	1949624	5564140
FL	Financial leverage	2.27	20.668
RASS	Rotation of assets (RASS=NT/TA)	1.727	1.126
SMAR	Sales margin (SMAR=EBT/NT)	0.028	0.086
FE	Fiscal effect (FE=EBT/EBIT)	0.768	1.089
LS	Legal standing (qualitative variable that takes value 1 if joint stock company and 0 if limited company)		
EXP	Exporting activity (qualitative variable that takes value 1 if the company exports and 0 otherwise)		
Sector-level			
SUB10X	8 qualitative variables that distinguish between the nine subsectors involved in the Valencia food industry, according to NEAC		
Macroeconomic-level			
YEAR	Qualitative variable that takes value 1 in an expanding economy and 0 in recession		
Territory-level			
CAS	Province of Castellón (qualitative variable that takes value 1 if company is located in Castellón and 0 otherwise)		
AL	Province of Alicante (qualitative variable that takes value 1 if company is located in Alicante and 0 otherwise)		

Note: N=4140, n=414, T=10.

Source: Compiled by the authors on Stata.

Table 2 refers to the representation of each subsector and each province in the sample of companies.

Table 2 - Number of companies in the sample by subsector and province

Subsector	Province of Valencia	Province of Alicante	Province of Castellón	Total Subsector
101. Meat processing and meat products	31	23	8	**62**
102. Fish and seafood preserves	7	7	2	**16**
103. Processed and preserved fruit and vegetables	23	12	4	**39**
104. Vegetable oils and animal fats	5	2	1	**8**
105. Milk products	13	11	4	**28**
106. Cereals and starch products	13	3	2	**18**
107. Bread and pasta	61	46	21	**128**
108. Other food products	48	50	11	**109**
109. Animal feeds	2	1	3	**6**
Total Province	**203**	**155**	**56**	

Source: Compiled by the authors.

Econometric model with panel data

The data set thus obtained for each company combines transversal and temporal dimensions and allows econometric models to be used that can detect hidden heterogeneity between companies or in time. This is a short or micro-panel since the number of companies is greater than the number of periods and is balanced since the number of periods is the same for all companies. Due to its higher number of observations, the panel data provide more information, less collinearity among explanatory variables, more degrees of freedom and more efficient estimations. They also make it possible to construct more complex behavioural models than transversal or time series models. Considering the limitations of the ANOVA or COV techniques used in most previous studies (Misangyi *et al.*, 2006; Hirsch *et al.*, 2014), this paper tests the application of an econometric model with panel data.

The general model was considered as follows:

$$Y_{it} = \alpha_{it} + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_k X_{kit} + u_{it}$$

Where $I = 1, \ldots, N$ y $t = 1, \ldots, T$; $X_1, X_2, \ldots, X_k$ are the explanatory k variables; $\beta_1, \beta_2, \ldots, \beta_k$ are the parameters; i represents the companies; t

represents time; u_{it} is the random perturbation that detects the heterogeneity caused by the company effects and/or time of non-observable variables; and α_{it} represents the model intercept, which can vary between companies and/or through time. The estimation techniques depend on the consideration given to the independent term. The three models used in the present study were those most frequently cited of the existing panel models (Gujarati & Porter, 2009):

1. Grouped ordinary least squares model. In this case, NxT observations are grouped, and regression is estimated without allowing for the transversal or time-series data. The independent term is considered to be constant for all companies and periods, i.e. $\alpha_{it} = \alpha$, obtaining the grouped model:

$$Y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_k X_{kit} + u_{it}$$

The model assumes that the regression coefficients are the same for all companies and that explanatory variables are non-stochastic, and if they were to be so, they would not be related to the perturbation term. The perturbation terms are also independent and identically distributed in a normal distribution with a mean of zero and constant variance. Its disadvantage is that it hides any heterogeneity among companies and does not indicate if the dependent variable's response to the explanatory variables with time is the same for all companies. Therefore, it is highly likely that the perturbation term will be related to some regressors and as a result, the heterogeneity among companies may induce autocorrelation, so that the model estimators will not be the optimal ones.

2. Grouped ordinary least squares model with variable dichotomy of fixed effects. NxT observations are grouped, but each cross-sectional unit is allowed to have its own dichotomous variable (intercept). There are N α_i terms, called fixed effects, one for each company in the individual fixed-effect models. The sub-index *i* is used to indicating that intercepts may differ due to inter-company differences. The Intercept α_i does not vary with time. Coefficients of regressors do not vary between companies or with time.

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_k X_{kit} + u_{it}, u_{it} \sim N(0, \sigma v^2)$$

The temporal fixed-effect model can consider variables that are constant among companies but change with time. There are T fixed time effects in this model, α_t varies in time but not among companies. The sub-index *i* is used to indicating that intercepts may differ in time. Regressor coefficients do not vary among companies or with time.

$$Y_{it} = \alpha_t + b_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_k X_{kit} + u_{it}, u_{it} \sim N(0, \sigma v^2)$$

The excess of dichotomous variables with large numbers of companies is the main disadvantage of this model, together with its multicollinearity, which can hinder estimations, and also the fact that perturbations u_{it} can present heteroscedasticity among companies or autocorrelation in time.

Dichotomous variables are added to the model to allow the fixed effect intercept to vary among the companies in time. To estimate the fixed-effect model, we here introduced nine dichotomous variables (DV_t), one for each year, to find any differences in the effects over time on economic and financial profitability.

3. Random effects model. This model assumes that α_{it} is a random variable that can be broken down into a constant part α, and another random part ε_i, which depends on company i but is constant in time. Substituting in the general model, we obtain:

$$\begin{aligned} Y_{it} &= \alpha_{it} + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_k X_{kit} + u_{it} \\ &= \alpha + \varepsilon_i + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_k X_{kit} + u_{it} \\ &= \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_k X_{kit} + W_{it} \end{aligned}$$

Where $W_{it} = \varepsilon_i + u_{it}$, ε_i is the component of the cross-sectional error, and u_{it} is the combination of the component of the temporal and cross-sectional error. The perturbations ε_i and u_{it} comply with the hypothesis $\varepsilon_i \sim N(0, \sigma_E^2)$ $u_{it} \sim N(0, \sigma v^2)$, i.e. the perturbation components are not related to each other nor are they cross-sectionally related in time.

Robust estimation of models. Since the panel data have a cross-sectional time dimension, perturbations can be expected to be heteroscedastic and correlated. To solve this, we will need a robust covariance matrix estimator, which can be used in the grouped model, in the fixed effects model and the random-effects model. In the present study, we used the robust estimator proposed by Arellano & Álvarez (2003) for panel data with Large N and Small T.

Models selection. Following Gujarati & Porter (2009) and Wooldridge (2011), to decide the right estimator we used: F contrast of multiple constraints to choose between the grouped ordinary least squares model and the fixed effects model; Lagrange de Breusch-Pagan multiplier contrast to choose between the grouped ordinary least squares model and the random-effects model; and Hausman contrast to choose between the fixed effects model and the random-effects model.

2. Results

The models described in the Methods section were tested and validated, including their interaction terms to optimize the capture of significant differences in returns and enhance their explanatory power. The most applicable model was then individualized after verifying its robustness, the results of which are offered in this section. Since the classic regression model hypothesis was not satisfied, the estimators of the grouped ordinary least squares model and the fixed effects model were not optimal, so that the results obtained by the t and F contrasts were not valid. In the fixed-effects model, this problem could be solved by a robust covariance matrix estimator. The Hausman contrast was used to choose between the robust model with variable dichotomy of fixed effects and the random-effects model[6].

2.1. *ROA Estimation Model*

As can be seen in Chart 1, since the P-value associated with the Chi-square test is less than the 5% significance level, the null hypothesis is rejected, so that the most suitable model to explain ROA is the robust model with variable dichotomy of fixed effects, whose significant results are shown in Table 3 and Charts 2 and 3.

Chart 1 - Hausman Contrast for ROA

Hausman contrast
H_0: the random-effects model is the right one since its estimators are consistent (null hypothesis)
H_1: the fixed effects model is the right one
Asymptotic contrast statistic: Chi-square (13) = 50.6307 with P-value = 2.32306e-006

Source: Compiled by the authors on Gretl.

6. Note that some independent variables that directly determine economic and financial profitability were proposed in the model (since they influence the calculation). As it was seen that these variables did not possess a high degree of multicolinearity, this did not invalídate the model; a large number of regressors were selected considered to be fundamental in determining profitability, so that it was decided to include them in the regression model to decide which one was significant and estimate its degree of significance in the industry under study. As a result, the models described below were validated and everything was found to be correct.

Table 3 - Robust model of fixed effects for ROA

	Coefficient	Standard Deviation	Statistic t	P-value
NT	2,15E-04	3,56E-05	60.451	<0.0001
TA	-2,81E-04	3,89E-05	-72.214	<0.0001
SMAR	0.688144	0.121798	56.499	<0.0001
EBITDA	6,47E-04	2,64E-04	24.547	0.0145
CAS*SMAR	0.407767	0.159872	25.506	0.0111
EXP*SMAR	0.441809	0.151596	29.144	0.0038
YEAR*RASS	0.0135938	0.00234179	58.049	<0.0001
SUB109*NE	0.00402927	0.00154413	26.094	<0.0001
DV 4	-0.0186556	0.00294512	-63.344	0.0250
DV 5	0.0102098	0.00453967	22.490	0.0097
DV 7	-0.00652927	0.00154413	-26.094	0.0094
Mean of dependent variable		0.038022	**D.T. of dependent variable**	0.102612
Sum of squares of waste		1.299.650	**D.T. of regression**	0.059147
R-square MCVF (LSDV)		0.701783	**R-square 'intra'**	0.534598
Log-likelihood		6.056.600	**Akaike criterion**	-11263.20
Schwarz criterion		-8573609	**Hannan-Quinn criterion**	-10311.48
Rho		0.204554	**Durbin-Watson**	1.336.026

Source: Compiled by the authors on Gretl.

Variables included in the model or those with significant coefficients at a level of α = 5% are considered. The model is conjointly significant, as can be seen from Charts 2 and 3. The coefficient of determination is 0.702, indicating that the estimated regression model explains 70.2% of the ROA variability.

Chart 2 - Contrast of overall significance of the robust model with dichotomous variable of fixed effects for ROA

Joint contrast of regressors (except the constant)
Contrast statistic: F (11. 413) = 39.9466
With P-value = P(F(11. 413) > 39.9466) = 2.8348e-058

Source: Compiled by the authors on Gretl.

Chart 3 - Robust contrast of different intercepts per group

Null hypothesis: the groups have a common intercept
Contrast statistic: Welch F (413, 1248.0) = 7.45971
With P-value = P(F(413, 1248.0) > 7.45971) = 6.86553e-168

Source: Compiled by the authors on Gretl.

The equation of the selected model is:

$$ROA = \beta_1 NT_i + \beta_2 TA_i + \beta_3 SMAR_i + \beta_4 EBITDA_i + \beta_5 CAS*SMAR_i + \beta_6 EXP_i*SMAR_i + \beta_7 YEAR*RASS_i + \beta_8 SUB109*NE_i + \beta_9 DV4 + \beta_{10} DV5 + \beta_{11} DV7 + u_i$$

According to this equation, every additional €100,000 of NT increases ROA by 0.022%, i.e., the firm's activity generates more profits than costs. Every additional €1m of TA reduces ROA by 0.281%, i.e., when the firm's investments or economic structure is increased, ROA is reduced. Therefore, to control assets, only the fixed assets necessary to complete the production cycle must be maintained, and the optimal stock levels must be kept that do not compromise the demand. Each additional €1m of EBITDA increases ROA by 0.647%.

Every additional percentage unit of SMAR increases ROA by 68.814% for a company in Valencia that does not export, while one that does export increases ROA by 112.995% (0.68814 + 0.44181). As regards non-exporting companies in Castellón the increase is 109.590% (0.68814 + 0.40776) and 153.770% (0.68814 + 0.40776 + 0.44180) for exporters. When the markets are enlarged geographically, exporters have a higher margin. Since the ALI*SMAR interaction term's parameter is not statistically significant, there are no differences between the marginal results of firms in Valencia and those in Alicante. Each additional RASS unit increases the difference between the expected ROA in a year of growth versus a year of recession by 1.359%, i.e., in phases of economic growth, rotation provides slightly higher ROA than in recessions, despite the inelastic demand associated with the sector.

Every additional employee increases the difference between the expected ROA by 0.403% in firms belonging to the Subsectors 109 and 101. Producers of meat products (101) in Valencia are usually on a smaller scale than animal feed producers (109) and the profits per employee are higher in the larger, more automated companies. In the remaining subsectors, the interaction parameters are not statistically significant at the 5% confidence level; they do not show relevant differences with Subsector 101 firms due to being of a similar size.

In the years studied, the difference between expected ROA in 2009 and 2012 with regard to 2006 should be highlighted, which is reduced by 1.866% and 0.653%, respectively. At that point in time, the region's economic situation could be described as a large-scale crisis, and 2009 and 2012 were among the worst years. Even so, the difference between expected ROA in 2010 and 2006 increased by 1.021%, and in the remaining years, no significant differences were detected, confirming the anti-cyclical nature of the food sector.

2.2. *ROE Estimation Model*

As can be seen in Chart 4, since the P-value associated with the Chi-square test has a significance level less than 5%, the null hypothesis is rejected and therefore the most suitable model to explain ROE is the robust model with a dichotomous variable of fixed effects. The results can be seen in Table 4 and Charts 5 and 6.

Chart 4 - Hausman Contrast for ROE

Hausman Contrast
H_0: ransom effects model is the correct one since its estimators are consistent (null hypothesis)
H_1: fixed effects model is the correct one
Asymptotic contrast statistic: Chi-square (18) = 56.2577 with P-value = 8.11495e-006

Source: Compiled by the authors on Gretl.

All the variables included in the model have significant coefficients at a level of α = 5%, and the model is also conjointly significant, as can be seen in Charts 5 and 6. The coefficient of determination is 0.554, which indicates that the estimated regression model explains 55.4% of ROE variability.

Table 4 - Robust fixed effects model for ROE

	Coefficient	Standard Deviation	Statistic t	P-value
CONST	-0.0866778	0.0210314	-41.213	<0.0001
RASS	0.0430677	0.0143126	30.091	0.0028
SMAR	125.961	0.255272	49.344	<0.0001
FL	0.00540052	0.00197477	27.348	0.0065
CAS*SMAR	124.972	0.456205	27.394	0.0064
YEAR*RASS	0.0290911	0.00442713	65.711	<0.0001
SUB106*NP	1,72E-02	6,24E-03	27.546	0.0061
SMAR²	0.698097	0.196884	35.457	0.0004
RASS²	-0.00550246	0.00130788	-42.072	<0.0001
DV 3	-0.0204723	0.0076181	-26.873	0.0075
DV 4	-0.0362286	0.00852164	-42.514	<0.0001
DV 6	-0.033453	0.00910141	-36.756	0.0003
DV 7	-0.0194333	0.00823527	-23.598	0.0188
Mean of dependent variable		0.035019	**D.T. of depndent variable**	0.221989
Sum of squares of waste		9.097.661	**D.T. of regression**	0.156511
R-square MCVF (LSDV)		0.553963	**R-square 'intra'**	0.325113
Log-likelihood		2.028.541	**Akaike criterion**	-3205082
Schwarzcriterion		-5.091.620	**Hannan-Quinn criterion**	-2251117
Rho		0.083614	**Durbin-Watson**	1.615.163

Source: Compiled by the authors on Gretl.

Chart 5 - Contrast of overall significance of the robust model with dichotomous variable of fixed effects for ROE

Joint contrast of regressors (except the constant)
Contrast Statistic: F (12, 413) = 21.135
With P-value = P(F(12, 413) > 21.135) = 3.22352e-036

Source: Compiled by the authors on Gretl.

Chart 6 - Robust contrast of different intercepts by groups

Null hypothesis: the groups have a common intercept
Contrast statistic: Welch F (413, 1248.0) = 11.2185
With P-value = P(F(413, 1248.0) > 11.2185) = 6.74913e-242

Source: Compiled by the authors on Gretl.

The equation of the selected model is:

$$ROE = \beta_0 + \beta_1 RASS_i + \beta_2 SMAR_i + \beta_3 FL_i + \beta_4 CAS{*}SMAR_i + \beta_5 YEAR{*}RASS_i + \beta_6 SUB106{*}NP_i + \beta_7 RASS_i^2 + \beta_8 SMAR_i^2 + \beta_9 DV3 + \beta_{10} DV4 + \beta_{11} DV6 + \beta_{12} DV7 + u_i$$

In the above equation, the negative intercept can be interpreted as a measure of opportunity cost (8.67%). Each additional RASS unit increases ROE by 3.207% (0.043 – 0.011) in recession years and 6% (0.043 + 0.029 – 0.011) in growth years. It should be noted that during recessions financing is more expensive than during growth. As ROE is a quadratic function of rotation with a negative coefficient, this indicates that the maximum point would be reached after which ROE decreases as rotation increases. Thus, in a growth year, ROE would begin to decline at rotation values over 655.71% and 391.35% during a crisis. These values are difficult to reach, even for firms that apply the cost leader strategy. Each additional SMAR unit increases ROE by 264.681% (125.061% + 139.620%) in firms outside Castellón, while for those in Castellón, the increase is 389.653% (125.061 + 124.972 + 139.620). However, there are no differences between the marginal propensities of a firm in Alicante and another in Valencia. ROE is also a quadratic function of the margin, with a positive coefficient, so that after a minimum point, ROE commences to rise with a rising margin.

Each additional FL percentage unit increases ROE by 0.540% so that choosing external financing seems to be a reasonable growth strategy. Every €1m of additional NP increases the difference between a firm's expected ROE in Subsector 106 and another in 101 by 17.20%. The meat sector (101) applies differentiation strategies with a higher profit margin than the cereals and starch products sector (106), which is much more competitive and offers a wider range of manufactured products.

The Great Recession seriously hindered access to external financing and made it more expensive, generating lower profitability on self-funds and making it difficult for some firms to repay these loans. The difference between the expected ROE of a firm in 2008, 2009, 2011 and 2012 as compared to 2006 declined by 2.047%, 3.623%, 3.345% and 1.943% respectively. Despite this, the loss of ROE was less drastic than in other sectors, due to the food sector being more resistant to cyclical economic variations.

Discussion and conclusions

Profitability is undoubtedly the most widely used measure of a firm's value-creating capacity. It can be expressed in two different ways: economic

profitability, which evaluates the efficient management of company assets, no matter how they are financed, and financial profitability, which quantifies the value transferred to the enterprise's owners. The business management literature has often studied the factors determining a firm's profits and why some firms earn more than others. However, there are a series of factors that influence profitability that can be divided into three categories: a) macro-economic factors attributable to the general economic and social situation in which the firms operate and are common to all firms alike; b) factors that refer to different organizational structures and technological characteristics pertaining to the sector and influence company strategies and results; c) business factors related to the particular characteristics of the company, such as its size, resources available and indebtedness capacity.

In this context, this work aimed to identify the factors that determine the ROA and ROE of firms involved in the Valencia food industry and determine their importance. This sector is without any doubt Valencia's most powerful industry and is inextricably linked to the region's economic development, both for the volume of its sales and the number of jobs it generates.

The sample of firms was obtained from the SABI database for the years 2006 to 2015, both inclusive, and was composed of active business firms involved in producing all types of foodstuffs with data available on their performance in each of the years of the study. From the analytical panel data methods tested, the robust model by ordinary minimums squares with a dichotomous variable of fixed effects was selected, in which ROA and ROE were the dependent variables. The explanatory variables were chosen from the elements most likely to determine profitability: firstly, corporate characteristics, net turnover, number of employees, and total assets (representative of company size according to the classification criteria of the UE's recommendation 96/280/CE), EBT, EBIT, EBITDA, net profits, self-funds, financial leverage, asset rotation, sales margin, fiscal effects, legal standing, and export activities; secondly, the macro-economic factors, included by a quantitative variable with a value of 1 in an expanding economy and 0 in a recession; thirdly, the effect of location or territory, contained in two qualitative variables that divided the locations into provinces (Valencia, Alicante and Castellón), and finally the sector effect, from eight qualitative variables that distinguished between the nine sub-sectors that compose the food industry, according to the NEAC.

Regarding the general question contained in the paper's title, the data indicate that the first measure of profitability (ROA) has a mean value of 3.8%. This figure differs from that given for the country's whole by the Bank of Spain's *Central de Balances*, which calculates a somewhat higher mean ROA for the food sector. This difference can be partly explained by the fact that the sample chosen in the present work did not include the extreme values

of the biggest firms in the sector, which have the best economic performance but are also those that most distort the results (extreme values distort the sample). Another explanation is that the average size of the Valencia food industry firms is smaller than in other regions. ROE was found to have a mean value of 3.5%, slightly lower than the ROA. The lower ROE of the Valencia food industry is because the companies obtain returns on their investment that are lower than the cost of outside financing, i.e., they have a lower indebtedness capacity. The ROE also differs from that given by the *Central de Balances*, which gives higher ROE than ROA for the whole of Spain, which indicates that the cost of debt is lower than the ROA obtained from industrial production, i.e., it has leverage higher than 1. According to the present study findings, in the Valencia Region, the cost of debt is greater than the profits earned from business, which means that ROA is higher than ROE. As mentioned previously, this can be explained by the fact that we excluded the largest food-producing companies in Valencia, which have the largest capacity for indebtedness.

The findings provide evidence that the firm effect can explain the profitability of the food industry, macro-economic situation, territory effect and sector effect, although the firm effect is without a doubt the most important and dominates all the others. These results are in agreement with similar earlier studies in the literature, in which most agree that the Theory of Resources and Capacities plays the leading role in explaining business profitability (Hough, 2006; Ketelhöhn & Quintanilla, 2012, Zouaghi *et al*., 2017).

The empirical results obtained indicate that ROA and ROE are both influenced by the sales margin (profit from each monetary unit sold); the higher the margin, the higher ROA and ROE, which was found to be especially true in the province of Castellón. Similar to previous studies (Zouaghi *et al*., 2017), the findings suggest that location does matter. According to Zouaghi *et al.* (2017), this is due to factors such as the distance to the nearest airport, the proximity to technological centres or universities, the degree of urbanization or the levels of regional education, which have a positive and significant impact for food industry firms in the Valencia Region. In this sense, Goldszmidt *et al.* (2011) found that the territorial effects are even higher for nonmanufacturing sectors such as agriculture than manufacturing firms. Asset rotation (number of monetary units sold by monetary units invested) helped increase both profitability measures during economic expansion. Similarly, the Great Recession reduced profits in 2009 and 2012, when the crisis reached its lowest depths.

ROA can also be explained by the company's size, EBITDA, and export activities due to their contribution to raising the margin (Yurtoglu, 2004). The influence of company size on ROA has a positive relationship with

net turnover and a negative one with total assets, both with a minimum effect that practically cancels each other. EBITDA and exporting activities positively influence higher profitability. It should be noted that in the subsector 109, whose larger companies make animal feed products, ROA rises with the number of employees. In spite of this, this inter-relationship is not considered conclusive and that the reason for the positive size-ROA relationship is only valid for large scale companies. Therefore, there is no optimal dimension of the Valencia food firms, and the expected positive relationship between size and profitability does not seem to be met (Law of Proportional Effect). In general, these results contradict the previous empirical evidence, which detected a positive relationship between company size and profitability (Misangyi *et al.*, 2006; Pindado & Alarcón, 2015, Zouaghi *et al.*, 2017). As regards the time effect, ROA was higher in 2010 than in 2006, the reference year, and allowed the losses made in 2009 to be recovered.

ROE can also be explained by asset rotation (in all years, although more marked in years of growth) and financial leverage (the higher the indebtedness capacity, the higher the ROE). The impact of financial leverage is positive. This result contradicts several previous empirical studies (e.g., Hirsch & Hartmann, 2014; Zouaghi *et al.*, 2017), but is in line with the classical risk theory. And the higher the net profits, the higher the ROE in subsector 106 (cereals and starch products). As regards the time effect, as shown by Chaddad & Mondelli (2013), the economic crisis seems to have lowered ROE more than ROA, which declined in 2008, 2009, 2011 and 2012. In addition, in line with Zouaghi et al. (2017), the impact of the financial crisis is low. This indicates that the food sector is a rather crisis-proof sector due to static demand for food products (Lienhardt, 2004).

The implications of our findings are as follows. Low profit margins on sales characterize the agri-food industry. The most effective recommendation for increasing future company profits is to modify sales prices in search of a higher commercial margin, i.e., choosing a product differentiation strategy based on innovation, accompanied by better management of relationships with clients and after-sales service could help to improve profits. Also, although with a less marked effect, improved asset rotation strategies could be useful, bearing in mind that both strategies are alternative ways of raising profits, since the higher the margin, the lower the rotation and vice versa. Since this sector is work-intensive, the cost of this strategy would be definitive, since, with such small margins, it is practically impossible for so many small companies to compete and innovate successfully. This change in strategy would help to raise profits and ensure the viability of the sector. There should be no doubts when choosing the company strategy. Strategic heterogeneity reduces profitability, and the cost leader strategy generates

few profits for small companies. Therefore, it is recommended that food companies opt for differentiating their products from the competition, since this approach is more appropriate for survival in competitive markets and satisfying the preferences of the most demanding customers.

The food industry is a highly saturated market characterized by high competition for retailer shelf space, implying that innovations play a major role in firms' staying in the market. It would also be advisable that the firms in the sector unite their resources and invest in R&D in order to introduce the latest technology into their production systems to improve their efficiency. It is essential for them to invest in innovation to improve productivity. Also, better coordination is required among producers and transformers to carry out joint research projects to improve sector competitiveness with the help of public organizations and business associations. There is also a lack of horizontal cooperation among these firms, and as the average size of the firms in the sector is quite small; in most cases, the owner/manager does not have enough training to manage marketing strategies efficiently.

However, there are possible opportunities available in the use of appellations of origin, tax rebates for cooperatives, grants from public bodies, etc., which would give products an official seal of quality and expand to new markets at home and overseas, without forgetting food safety requirements. This is the path that the sector must take to meet the needs of their most demanding consumers for the healthiest products from an environmentally friendly production system. The agri-food industry is one of the Spanish economy's strongest sectors both in turnover and in the number of jobs it provides. It is vital to maintain a competitive position to expand internationally both inside and outside the EU. Thus, the sector can be described as being in a good position to face whatever comes in the present economic situation.

This paper has certain limitations: firstly, since the sample was composed of regional firms, the economic-financial interpretation of the situation could differ from a sample composed of firms from all over the country. Secondly, the data available does not always allow some possibly relevant variables to be included in the empirical analysis, especially intangible variables such as technology and reputation. Thirdly, due to the huge volume of data, although divergence could be analyzed among subsectors, it was not possible to carry out this process among the companies themselves.

Possible future lines of research could include the study of a sample from the whole of Spain to confirm the principal results and identify possible divergences among the different regions (Autonomous Communities). It would also be interesting to measure the productivity of the food industry and its subsectors, including the relationship between sales per working hour and profits per working hour in order to find the most cost-efficient

subsectors. The scope of each effect within the subsectors could be separated and measured to estimate each one's representative magnitude in economic and financial performance. Econometric model alphas could also be awarded to each firm in a subsector to determine divergences in profitability. The dynamic modelling approach could be applied and compared with the robust fixed-effect model (Hirsch & Gschwandtner, 2013). Finally, it would be desirable to compare the agri-food sector with other sectors to determine their similarities and divergences, plus all the factors involved in their success or failure.

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Economia agro-alimentare /
Food Economy

An International Journal on Agricultural and Food Systems

Vol. 23, Iss. 1, Art. 4, pp. 1-28 - ISSN 1126-1668 - ISSNe 1972-4802
DOI: 10.3280/ecag1-2021oa11391

The economic and environmental sustainability of extra virgin olive oil supply chains: An analysis based on food miles and value chains

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Abstract

Following the growing trend towards globalisation of the agri-food system over the last few years, a number of scientific publications with different aims and methodological approaches have addressed the issue of the progressive link loss between the place of consumption and production of food. In part, the scientific debate has focused on the various agri-food production commercial outlets, highlighting the strengths and weaknesses of both the dominant models like mass market retail, as well as emerging models like solidarity purchasing groups

The present study can be classified as concerning the sustainability of agri-food supply chains. It compares five different extra virgin olive oil (EVOO) supply chains in terms of the distance between the agricultural producer and end consumer, from both an economic perspective (the number of intermediaries) and a geographical one (production and consumption places). The examined aspects are 1) all the supply chain segments in which value is added to what will be the final food product purchased by the consumer, with a focus on trade and the transport cost estimated in relation to food miles; 2) the environmental impact of transport along the entire supply chain

Article info

Type:
Article
Submitted:
04/11/2020
Accepted:
22/02/2021
Available online:
31/05/2021

JEL codes:
Q13, Q56

Keywords:
Agri-food chain
Purchasing models
LCA
CO_2 emissions

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up to the distribution of EVOO to the final consumer; and 3) the trade-offs between the environmental impact and economic results.
The results obtained confirm some existing general evidence in the literature, such as the greater enhancement of agricultural products through short supply chains, and they emphasize as combining the value chain results with the environmental impact based on food miles, no real trade-offs, but rather trends, emerge.

Introduction

Several studies on supply chains have recently focused on sustainability issues in response to the growing concern for the environmental impact of food supply chains (Training and Research Institute for Transport [ISFORT in Italian], 2013; Cicatiello *et al.*, 2012b). This growing consumer environmental attention results in an increase in the demand for locally produced food that is considered safer for health, and towards more social and environmental sustainability (Akaichi *et al.*, 2016; Cecchini *et al.*, 2018; Polenzani *et al.*, 2020).

The concept of sustainability is very broad and defining it in the context of an agri-food chain is not an easy task. Generally, three dimensions are used: environmental, economic, and social. Specifically, the economic dimension refers to economic growth, investments in human and social capital, changes in consumption patterns, price stability and transparency, and the strengthening of the farmers' role. On the other hand, the social dimension refers to food safety, human health and nutrition, animal welfare, the increase in jobs, equity conditions, and ethical principles. Therefore, sustainability can be understood as a particular quality exhibited by the supply chain, while the sustainability condition as the capability to maintain satisfactory environmental, social, and economic conditions over time.

The not-easy explanation of the concept of agri-food supply chain sustainability, the growing consumer's request towards sustainable food production, and excessive proliferation of standards and labels not always clear and easily understood (Abitabile, 2015), lead to a risk to confuse the consumer. On the other side, however, empirical evidence underlines the benefits of a label that indicates the environmental effects of transport, as underlined by Caputo *et al.* (2013a, 2013b) in studies concerning consumers' responses to two types of food miles (FMs) labelling, one with CO_2eq emissions information, and a second with the kilometres travelled by the product and travel times information.

As a consequence, more empirical research is needed to provide scientific value to the intuitive concepts of FMs and local production, allowing consumers to make informed consumption choices and public decision-makers to develop policies capable of integrating agricultural, environmental, and nutritional objectives (Garnett, 2011).

The present study tried to go one step further this research need: the analysis of the different organisational methods of the supply chains made it possible to compare the environmental impact of transport with the allocation of the economic benefits.

In particular, this study focuses on assessing the environmental sustainability of the FMs of EVOO supply chains, the consumption patterns of conventional and organic EVOO, and the economic sustainability of the agricultural sector, which is considered the weakest link in the supply chain.

The environmental sustainability was measured as the carbon footprint generated by the FMs compared to the flow of raw materials, semi-finished and finished products of agricultural origin in the different supply chain phases; the carbon footprint of the FMs is determined through a life cycle assessment (LCA). The economic sustainability was calculated as the added value (AV) generated in each exchange along the supply chain, with regard to the money flows, which, starting from consumers, reach the farmers.

1. Background

1.1. *Food miles*

The food system globalisation has increased the distance between the food production place and the food consumption places (Hendrickson, 1996; Pretty *et al.*, 2005; Kissinger, 2012). This phenomenon has led scholars to examine how local distribution chains can contribute to reducing energy consumption and greenhouse gases (GHGs) emissions (Pirog *et al.*, 2001; Smith *et al.*, 2005; Mariola, 2008; Cholette & Venkat, 2009; Blanquart *et al.*, 2010; Mundler & Rumpus, 2012; López *et al.*, 2015). FMs, defined as 'the distance that food travels between primary producer and end consumer' (Lang *et al.*, 2001, p. 539), have rapidly become the subject of a wide debate on local food and local eating issues, which are often described as systems capable of reducing FMs (Coley *et al.*, 2009; Edwards-Jones *et al.*, 2008).

These results are often conflicting, and some of them underline that an FM reduction linked to a local supply does not necessarily lead to an improvement in agri-food systems' sustainability. The reason is that the economies of scale and the logistical organisation improvement of the supply

systems operating in mass market retail (MMR) offset the impact generated by the average increase in the distance covered by food (Smith *et al.*, 2005; Cairns, 2005; Coley *et al.*, 2009; Schilich *et al.*, 2006; Rizet *et al.*, 2010; Malak-Rawlikowska *et al.*, 2019). In contrast, some authors state that the reduction in the distances travelled and the number of intermediaries allow for a reduction in energy consumption (Pretty *et al.*, 2005; Blanke & Burdick, 2005; Torquati *et al.*, 2015). Other authors indicate that focusing attention solely on FMs could result in losing sight of the several other types of value and meanings that consumers attribute to local food and eating, such as food freshness, support for local producers, and the wish to bring production and consumption places closer together (Schnell, 2013; Bazzani & Canavari, 2017). Others emphasise that there is no single relationship between distance travelled and environmental sustainability (Edwards-Jones *et al.*, 2008; Lee *et al.*, 2015). Further, others argue that to express an overall judgment on the alleged lower environmental impact connected to local food systems, an assessment based on the entire food life cycle would be necessary, that is, from the production of the raw materials to the waste disposal generated by their consumption (Plassmann & Edwards-Jones, 2009). Thus, the focus is shifted to food chain sustainability (Van Passel, 2013).

In recent years, researchers and experts have increased their interest in studying local food supply systems and their effects in terms of social and environmental benefits (Marsden *et al.*, 2000; McIntyre & Rondeau, 2011; Cicatiello & Franco, 2012a; Marino & Cicatiello, 2012; Michel-Villarreal *et al.*, 2019). In these studies, FMs have been used increasingly frequently as an indicator of the environmental benefits of local food chains due to the lower CO_2 emissions (Pirog *et al.*, 2001; Jones, 2002; Smith *et al.*, 2005; Foster *et al.*, 2006; Weber and Matthews, 2008; Coley *et al.*, 2011; Garnett, 2000; Kemp *et al.*, 2010; Hiroki *et al.*, 2014; Torquati *et al.*, 2015; Galli *et al.*, 2015; ISFORT, 2013). Furthermore, numerous studies on FMs have estimated consumers' perception of the distances travelled by food and the value attributed to this information (Caputo *et al.*, 2013a, 2013b; Kemp *et al.*, 2010; Sirieix *et al.*, 2008; Akaichi *et al.*, 2016).

It is currently agreed that the validity of FMs as an indicator of the local food chains' sustainability depends on the following two elements of the sustainability assessment: (1) the simultaneous use of additional indicator sets that also include transport modes, rather than a single indicator based on the distance travelled, and (2) the possibility of including economic and social aspects associated with these systems. Furthermore, it is considered necessary to conduct additional empirical research to improve the logistical efficiency of local food networks, so as to avoid cancelling out the environmental benefits induced by the reduction of the distance between food production and consumption (Smith *et al.*, 2005; Van Passel, 2013).

1.2. *Value chain*

Vertical integration analysis incorporated Porter's value chain theory, which was designed for businesses to highlight the costs of elementary activities and to understand the nature of the competitive advantage in each of the activities that businesses perform (Porter, 1985). In fact, Porter considers a company as a system of interdependent activities aimed at creating value for the customer (Porter, 1985).

The extension of the value chain concept to the chain's relationships with the suppliers and customers leads to the value system of the supply chain, as well as to the strategic analysis of the various economic agents who collaborate for value creation (Antonelli, 2011). In this context, the value chain is made up of a series of actors (or stakeholders) – from input suppliers, producers, and processors, to exporters and buyers – engaged in the activities required to bring a product from its conception to its end-use (Kaplinsky & Morris, 2001). Therefore, the value chain represents a tool for analysing and decomposing the value generation process.

Often, the agri-food chain fragmentation and the farmers' low market power create the farmers' increasing difficulty in retaining a consistent value share, both in absolute and relative terms, compared to the final product value purchased by the consumer. This lack of a consistent value share works to the advantage of agents downstream and upstream of the supply chain (Italian Institute for Food and Agricultural Market Services [ISMEA in Italian], 2012; Munasinghe *et al*., 2019; Jäckering *et al*., 2019).

The analysis of the agri-food value chain is a very complex operation. The ISMEA has conducted this analysis for Italy by using the inter-sectoral tables of the Italian economy, which allow tracing all the economic activities that are involved in the creation of a product.

Following a macroeconomic and top-down approach, the ISMEA has developed a value chain to quantify the value subdivision of goods produced by the agricultural sector and the food industry, and purchased by final consumers. In other words, it includes the economic subjects that directly and indirectly become part of the production and distribution processes (ISMEA, 2012). The method used may be considered as a subdivision of the price paid by consumers among all economic agents who directly and indirectly contributed to the purchased good or performed service. It results in useful information for understanding the contribution of the various processes and products that are involved in supply chains to the value chain. The final sale price, therefore, is considered as the result of the AV provided by each sector that participates in the production cycle. The starting point of the analysis is precisely the price paid by the final consumer, which represents the value that the buyer attributes to that given food and which is also affected by the contribution of the different actors involved in the production, processing, and

availability of food in the manner the consumer likes.

The results obtained highlight the constant downsizing of value in the primary phases of food production, compared to all the activities that occur from the moment the product leaves the 'gate' of the farm, until the moment of its sale to the final consumer (ISMEA, 2012). This downsizing process is also justified by the evolution of consumption styles, in which service and several material and nonmaterial aspects, more often generated and added in the phases closest to the consumer, are of increasing importance (ISMEA, 2012).

2. Materials and methods

2.1. *Purchasing models and identification of the supply chain*

The micro-economic approach was used to analyse the environmental and economic sustainability of the EVOO supply chain, starting with the analysis of the purchasing habits of eight families living in the Umbria region, whose members are customers of shops located in Perugia, the regional county seat.

The purchasing habits data were collected in 2013 using purchase booklets created ad hoc for the survey, where the 8 families recorded their purchases of EVOO and 13 other food products consumed weekly during the four seasons.

Specifically, for each product, the families were requested to report the following on the purchase booklet: purchase date, food description indicating whether the food was organic or not, quantity, brand, packaging type, price, company logo, and types of stores.

The collected data were first used to classify families based on eating habits[1] and, subsequently, to characterise them based on their prevailing

1. The classification criteria adopted to define the families' eating habits were purchase frequency of organic products, proportion of organic products purchases out of the total purchases (expressed as a percentage), number of organic products purchased, proportion of organic products consumed out of on total number of products consumed (expressed as a percentage). Families were classified as follows: 1) 'Conventional' if they did not buy organic products. 2) 'Organic-weak' (org-weak) if they met at least two of the following conditions: (a) they bought organic products less than once a week, (b) their organic products expenditure amount was less than 20% of their total expenditure amount, (c) they purchased no more than n. 3 different organic foods, and (d) less than 20% of food amount they consumed was organic. 3) 'Organic-strong' (org-strong) if they met at least two of the following conditions: (a) they bought organic products more than once a week, (b) their organic products expenditure amount was equal to or larger than 20% of their total expenditure amount (c) they bought more than n. 3 different organic foods, and (d) more than 20% of the food amount they consumed was organic.

purchasing habits at the different stores. The following seven purchasing models resulted from this analysis:

1. conventional family that mainly purchases from 'Emisfero' and 'Famila' supermarkets;
2. conventional family that mainly purchases from 'Todis' and 'Eurospin' discount stores and local markets;
3. conventional family that mainly purchases from 'Pam' supermarkets, 'Carrefour' hypermarkets, and traditional shops;
4. organic-weak family that mainly purchases from 'COOP' hypermarkets, 'CONAD' supermarkets, and supermarkets specialising in the distribution of organic products such as 'NaturaSì';
5. organic-weak family that mainly purchases from 'Auchan' and 'Carrefour' hypermarkets and small shops specialising in the distribution of organic products;
6. organic-strong family that mainly purchases from supermarkets specialising in the distribution of organic products such as 'NaturaSi';
7. organic-strong family that mainly purchases from organic solidarity purchasing groups (SPG).

Subsequently, to conduct both an environmental and economic analysis and compare the organic and conventional supply chains, the seven purchasing models above were analysed according to four key elements:

1. the purchased product and the origin of both the raw materials and semi-finished products expressed as the distance (in kilometres) the product travelled to reach the store;
2. the store where the purchase was made, representing the commercial organisation and distribution logistics;
3. the brand owner, representing the main element of the supply chain;
4. the price paid by the family, representing the economic value of the value chain.

Combining the four key elements with the seven purchasing models, five types of supply chains were identified, characterised by four aspects: (1) the product type, (2) the origin of the raw materials, (3) the main element of the supply chain (agricultural entrepreneur who owns the local brand, processing industry of the industrial brand, or distributor of the commercial brand or private label), and (4) the place of purchase by the consumer (SPG, specialised shop [SpShop], or MMR). The five types of supply chains identified are:

- Org_SPG_Ita: organic, local brand EVOO from Italian-origin raw materials, purchased from an SPG;
- Org_SpShop_Ita: organic, local brand EVOO from Italian-origin raw materials, purchased in a specialised organic products shop;
- Org_MMR_Ita: organic, commercial-brand EVOO from Italian-origin raw materials, purchased in an MMR shop;

- Conv_MMR_Ita: conventional local-brand EVOO from Italian-origin raw materials, purchased in an MMR shop;
- Conv_MMR_Int: conventional commercial-brand EVOO from international raw materials, purchased in an MMR shop.

2.2. *Value chain reconstruction*

The value chain reconstruction is based on the data collected on the purchase of a 1-litre bottle of EVOO, outlining the sequence of the elementary operations and distinguishing the following phases: agricultural, industrial or artisanal, packaging, marketing, distribution, and transport.

The survey was conducted in 2014 through direct interviews with 15 Umbrian economic agents, as summarised in Table 1. Beside the limited sample size, which could affect the accuracy of the analysis, the descriptive nature of the economic and environmental analysis implemented does not assume the adoption of an inferential statistical framework. To this regard, no mandatory characteristics in term of sample size and representativeness are required.

Thanks to the agents' collaboration, it was possible to reconstruct in detail the value chains of both local and national supply chains, as well as the kilometres travelled by the food, from where the raw materials were produced to where the food was sold. Concerning the reconstruction of international supply chains, the information collected, which in some cases was incomplete, was integrated with additional data from the literature, available through commodity exchanges records, and the Internet.

Table 1 - Interviewed economic agents for EVOO networks

Tipology	**Number**
Organic farm	2
Conventional farm	2
Oil mill	2
Agri-food industry	1
Handicraft packaging company	1
Mass market retail - headquarter	2
Mass market retail - point of sale	2
Traditional point of sale	1
Solidarity Purchasing Group	2
Total	15

Transport costs were estimated by using the unit costs for international transport of goods (Pastori *et al.*, 2014) imported from Italy by transport mode (euros per tons, weighted average of the volumes). These data are published by the Bank of Italy and the National Institute of Statistics (ISTAT in Italian), the Centre d'Études Prospectives et d'Informations Internationales, and on the Searates site[2]. Further, the road transport costs calculated by the Ministry of Transports and available on its website[3] were used.

Inspired by the methodology used by the ISMEA (2012), but using a bottom-up approach, we split the value of the goods purchased by families across all the supply chain actors. In particular, the price paid by the final consumer for a 1-litre bottle of EVOO was broken up as follows: 1) into the amount allocated to cover the value of the raw material (olives); 2) in the AV created by milling activity (using an oil conversion index of 17%); 3) in the AV created by bottling, packaging, and storage activities; 4) in the AV generated by transport across the entire supply chain; 5) in the AV generated by the organisational activities in some supply chain phases (conducted by farmers or by the first processing industry in the chain); 6) in the AV generated by distribution companies; 7) in the AV created by the stores; and 8) in the 4% share of the value added tax (VAT).

2.3. *Calculation of FMs and equivalent CO_2 emissions*

Consistent with the objectives of the analysis, after the reconstruction of each supply chain, the FMs were calculated in terms of the standard unit of measurement [t-km], defined as the transport of one tons of a product by a generic means of transport for a distance of 1 km.

Through the interviews, FMs were estimated by reconstructing the distances and the types and technical characteristics of the vehicles used in the transport. For the international supply chain, the data were adjusted based on the origin of the materials and the hub of international trade.

Subsequently, the environmental impact was calculated based on the 'cradle to gate' LCA approach, computing the emissions of GHGs, represented by equivalent CO_2 (CO_2eq) for the transport process of each supply chain.

To perform the aforementioned calculations, the SimaPro ver. 8.0.2 software and Ecoinvent database v2.0 were used (Frischknecht *et al.*, 2007), in accordance with the International Organization for Standardization (ISO) 14040 (ISO, 2006) and 14044 (ISO, 2006).

The GHGs emissions were expressed in terms of Global Warming Potential (GWP), with a return period of 100 years, considering the following

2. www.searates.com/reference/portdistance.
3. www.mit.gov.it/mit/site.php?p=cm&o=vd&id=3035.

emission factors in the CO_2eq calculation: 1 kg of CO_2eq for 1 kg of CO_2eq, 1 kg of CH_4 for 25 kg of CO_2eq, and 1 kg of N_2O for 298 kg of CO_2eq.

The functional unit was referred to 1 litre of EVOO. The data collection included primary data collected through direct farm surveys; if absent, these data were integrated with secondary data from the database Ecoinvent v2.0.

The system boundaries included all the logistics operations of movement and transport, from the production site of raw materials to the transformation and consequent packaging, until the final retail distribution of the product.

In particular, based on the diesel and lubricants consumption estimated at the primary level, the transport was modelled by adapting the related processes from the Ecoinvent v2.0 database, specifically: a) road transport with a van with a capacity less than 3.5 tons and average load of 1 ton; b) road transport with lorries with a capacity between 7.5 and 15 tons, with an average load of 6 tons; c) road transport with 16 and 32 tons lorries with an average load of 5.79 tons; d) road transport with lorries over 32 tons with an average load of 19.2 tons; e) sea transport on Roll-on/Roll-off (Ro-Ro)[4] ships and with bulk liquid storage. Given the absence of primary data, in maritime transport cases, a transoceanic ship was assumed to be the mode of transport, in accordance with the related process in the Ecoinvent database. In particular, following Spielmann *et al*. (2007), each transport process was modelled through the following three components: the transport operation, the vehicle use, and the infrastructure use.

The first component includes all the directly connected sub-processes, quantifying the emissions related to the fuel combustion, its production, and mineral oil production. The second component concerns the indirect impacts of the means of transport used, from the production of the vehicle itself, its maintenance, and the related disposal. The third component considers the impacts related to the use of the road infrastructure system.

The methodology described above allowed us to obtain the GHG emissions amount for each supply chain examined, expressed in terms of the CO_2eq kg for the transport of 1 litre of EVOO.

3. Results and Discussion

Figures 1 and 2 show graphic representations of the five supply chains examined, showing the system boundaries, the economic agents involved, and the kilometres travelled.

4. Roll-on/roll-off (Ro-Ro) ships are cargo ships designed to carry wheeled cargo, such as cars, trucks, semi-trailer trucks, trailers, and railroad cars, that are driven on and off the ship on their own wheels or using a platform vehicle, such as a self-propelled modular transporter.

Figure 1 - System boundaries, economic agents and kilometres travelled for organic EVOO purchased in Perugia shops

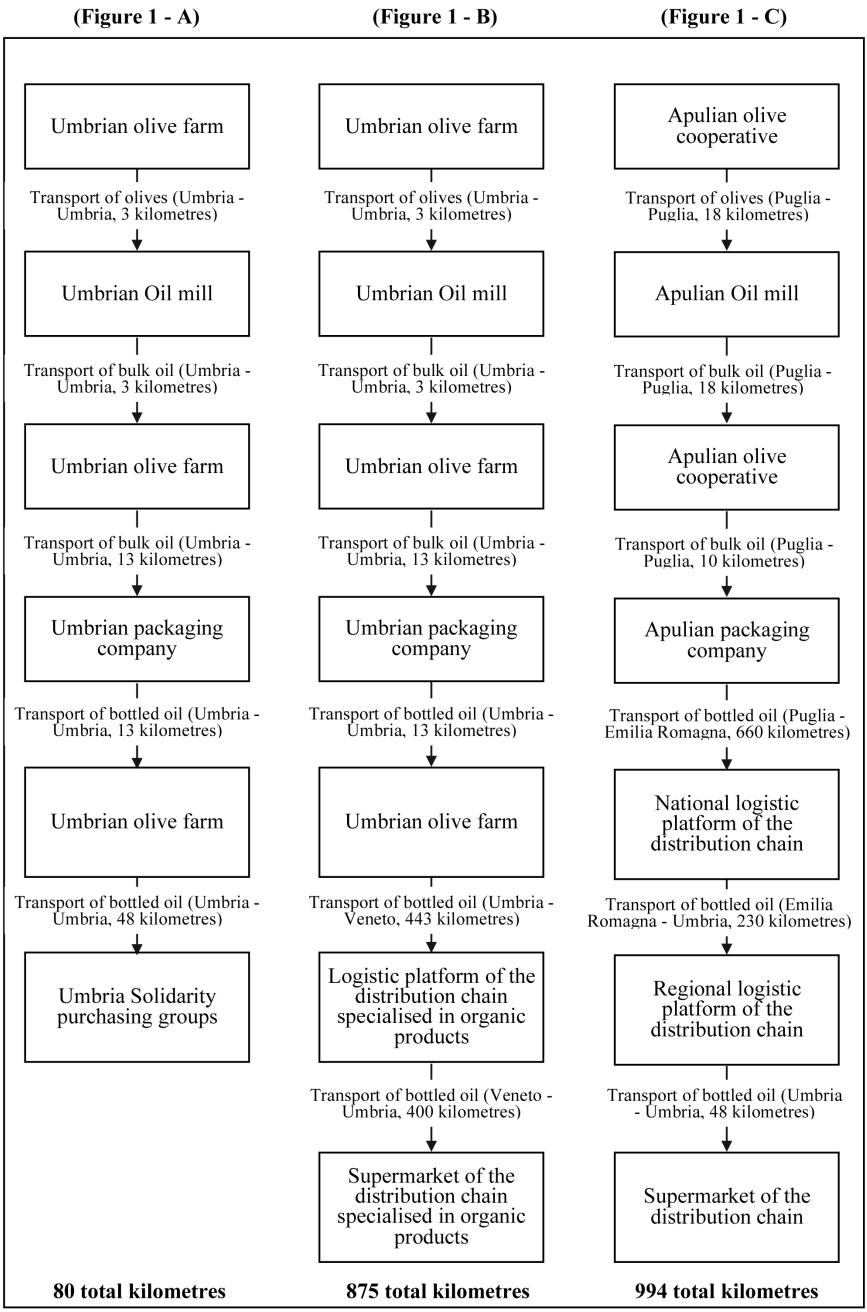
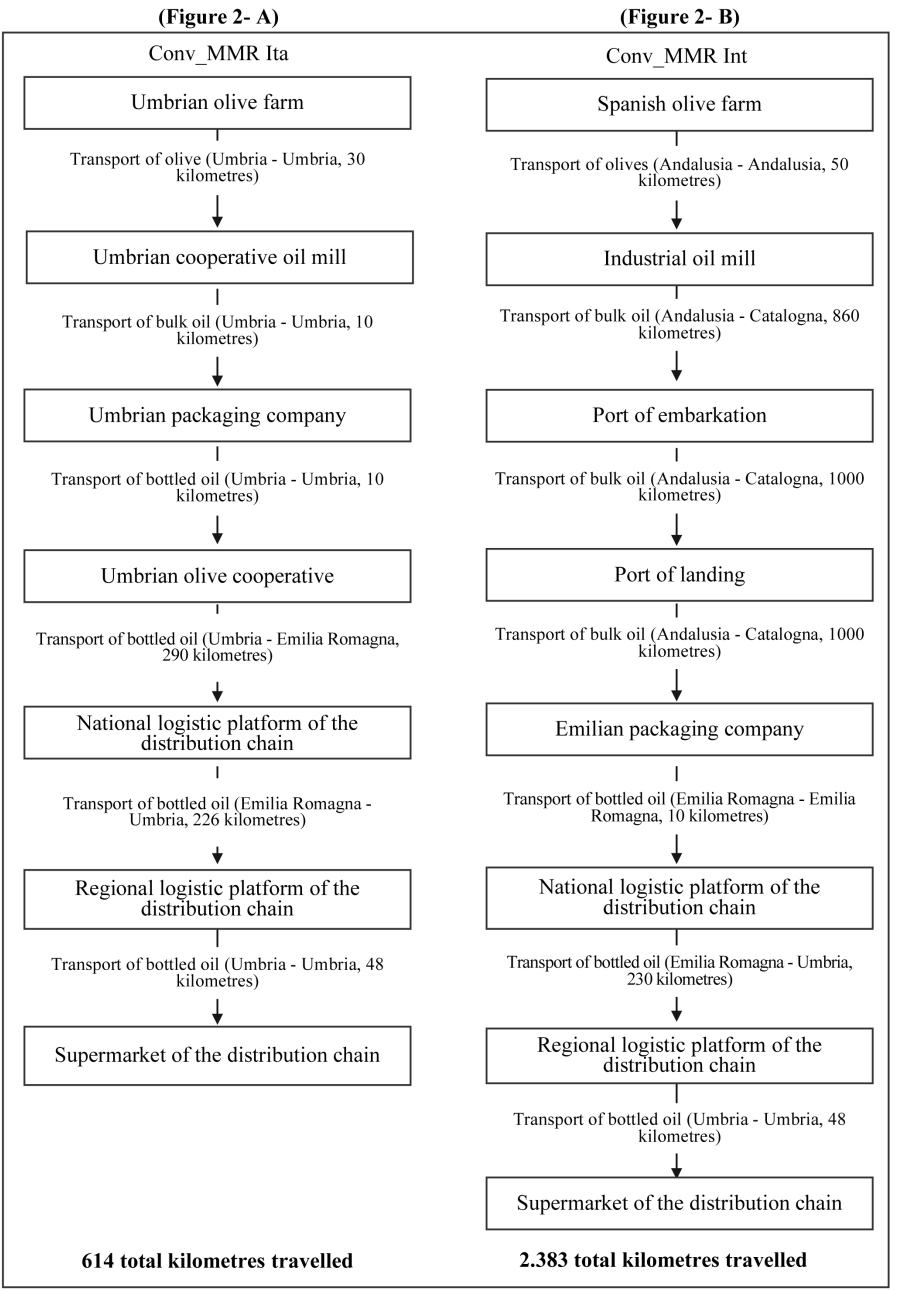


Figure 2 - System boundaries, economic agents and kilometres travelled for conventional EVOO purchased in Perugia shops



The Org_SPG_Ita supply chain (Figure 1-A) is a typical short organic supply chain managed entirely by a farmer, which deals with the production of olives and organises all the other phases of the supply chain using third-party services for the milling of the olives, the bottling, and the packaging. The farmer sells the product through the local SPG of which he is a member.

The value chain analysis highlights that the purchase price paid by the organic-product consumer is €15.00/1 litre bottle. Specifically, the olive production corresponds to 39% of the final price while the milling represents 7%, the bottling, packaging, and storage 14%, and the transport costs along the entire supply chain 1% of the final price. The farmer organisational activities correspond to 18%; the SPG distribution, which imposes a 21% mark-up on the purchase price it pays to the producer, represents 17% of the final price. Finally, VAT corresponds to 4% of the final price (Table 2).

The farmer values his/her work, both as an olive producer who is guaranteed a remuneration of €1,000/tons, which corresponds to the fine organic olives market price, and as a producer of EVOO, for which he/she obtains a mark-up of 30% on the total production costs (from the raw materials value to the transport costs). It should be noted that transport costs are limited (€ 0.14), given the shortness of the supply chain.

The AV that depends on the farmer through the organisational activities performed in the different phases of the supply chain is drastically reduced when the farmer sells his/her product through a specialised organic product distribution chain, such as the Org_SpShop_Ita supply chain (Figure 1-B). In fact, in this case, the farmer becomes a direct supplier of an organised distributor and the product follows the typical path of large-scale retailers: it starts from the farm and travels to the distribution chain logistics platform and then returns to the shops in Perugia. In this case, EVOO travels across 875 km and the commercial mark-ups are very different from those of an SPG.

From the value chain analysis, it appears that the purchase price paid by the organic-product consumer reaches € 20.00 for a 1 litre bottle, identical to the one commercialised in the SPG chain. Specifically, agricultural activities correspond to 29% of the final price and milling activities to 5% of that price, whereas bottling, packaging, and storage represent 10% of the final price. The transport costs along the entire supply chain correspond to 7% of the final price and the farmer organisational activities to 4% while the distribution and marketing activities at the distribution centre and shops represent 39% of that price (Table 2).

In this case, as in the Org_SPG_Ita supply chain, the farmer manages to enhance his/her work as an olive producer with a remuneration of €1,000/ton, but he/she values his work as a bottled oil-producer much less, applying a mark-up of only 8% on the total production costs (from the raw materials value to the transport costs). It should be noted that transport costs start from

Table 2 - Value chains in EVOO supply chains

	Organic EVOO (Euros/1 litre bottle)			Conventional EVOO (Euros/1 litre bottle)	
	Org_SPG Ita	**Org_SpShop Ita**	**Org_MMR Ita**	**Conv_MMR Ita**	**Conv_MMR Int**
Purchase price paid by final consumer	15,00	20,01	15,80	6,64	5,49
Value added tax	0,58	0,77	0,61	0,26	0,21
Added value generated by solidarity purchasing groups	2,49		–	–	–
Added value generated by distribution companies and stores	–	7,85	6,75	2,13	1,76
Added value generated by the organisational activities conducted by farmers	2,75	0,84	–	–	–
Added value generated by the organisational activities conducted by the first processing industry	–		0,77	0,20	0,17
Added value generated by transport	0,14	1,50	0,11	0,45	0,34
Added value generated by bottling, packaging, and storage activities	2,06	2,06	1,76	0,55	0,55
Added value generated by milling activity	1,10	1,10	1,10	0,70	0,70
Value of the raw material (olives)	5,88	5,88	4,70	2,35	1,76
Values in %					
Purchase price paid by final consumer	100%	100%	100%	100%	100%
Value added tax	4%	4%	4%	4%	4%
Added value generated by solidarity purchasing groups	17%				
Added value generated by distribution companies and stores		39%	43%	32%	32%
Added value generated by the organisational activities conducted by farmers	18%	4%			
Added value generated by the organisational activities conducted by the first processing industry			5%	3%	3%
Added value generated by transport	1%	7%	1%	7%	6%
Added value generated by bottling, packaging, and storage activities	14%	10%	11%	8%	10%
Added value generated by milling activity	7%	5%	7%	11%	13%
Value of the raw material (olives)	39%	29%	30%	35%	32%

€ 0.14/litre to € 1.50/litre, which is more than the AV derived from milling. These costs are also partly due to the low quantities transported, both in the first phases of the supply chain and in the transport to the logistics platform of large-scale retailers.

The third organic supply chain considered was Org_MMR_Ita (Figure 1-C) and it concerned the production and distribution of EVOO by a commercial brand that claims to use only Italian organic olives. In this case, the same society owns the private label and deals with all supply chain phases using third-party services, located in Italy. It sells the product at its own shops.

The value chain analysis highlights that the purchase price paid by the organic-product consumer is € 15.80 for 1 litre bottle of EVOO. Specifically, the cost of olives, produced in Southern Italy and standing at a market price of € 800/tons, corresponds to 30% of the final price while the milling to 7% of that price. The bottling, packaging, and storage represent 11% of the final price, whereas the transport cost along the entire supply chain corresponds to 1% of that price. The society that owns the trademark attributes 5% of the AV to the processing industry while the distribution activities, which result in a total mark-up of 80%, correspond to 43% of the final price of 1 litre bottle of organic EVOO (Table 2).

In this supply chain, the Southern Italian farmer is only a raw materials supplier while the transport cost is limited, despite the almost 1,000 kilometres travelled, due to both the transport means used and a better organisation of logistics.

The fourth supply chain considered was Conv_MMR_Ita (Figure 2-A) and it concerned the production and distribution of a conventional EVOO of a well-known national brand that claims to use only Italian olives. It is one of the typical supply chains of conventional EVOO, in which the agri-food industry deals with the production and the MMR addresses the distribution aspects.

The value chain analysis highlights that the purchase price paid by the conventional-product consumer is € 6.64/litre of EVOO. Specifically, the value of the olives, produced in Central Italy and reaching a value of € 400/tons, corresponds to 35% of the final price of 1 litre of EVOO. A share of 11% of the price paid by the conventional-product consumer represents the AV for the milling, while another 8% of AV corresponds to the bottling, packaging, and storage activities. The cost of transport constitutes 7% of the final price of 1 litre of EVOO, while the AV of the activities conducted by the processing industry is only 3% because its commercial policy is focused on the quantities it manages to sell thanks to MMR. Finally, the AV from the distribution centre and the shop represents 32% of the purchase price paid by the consumer (Table 2).

The fifth supply chain was Conv_MMR_Int (Figure 2-B) and it concerned the production and distribution of a conventional EVOO of a brand that is widespread on a national level and that does not claim to use only Italian olives. In this supply chain, the agri-food industry handles the production, also importing large quantities of olive oil (in this case, from Spain), and the MMR manages the distribution aspects. The value chain analysis highlights that the purchase price paid by the conventional-product consumer corresponds to 32% of cost of the raw materials from Spain, which stands at a market price of € 300/tons of olives. The milling represents 13% of the final price, while bottling, packaging, and storage constitute 10%, and the transport costs along the entire supply chain correspond to 6% of the final price. The AV of the organisational activities of the processing industry (3%) and that of distribution and marketing activities (32%) is similar to that of the previous supply chain, which implies similar commercial strategies are used (Table 2).

Among the different types of organic EVOO, the highest remuneration for raw materials occurs with sales through SPGs (€5.88/litre, corresponding to 39% of the selling price), while among conventional types, the raw materials remuneration is significantly lower (€2.35/litre), especially for imported EVOO (€1.78/litre). Generally, in longer supply chains, whether of organic or conventional EVOO, a significant AV share benefits the distribution and commercial chains.

To calculate the FMs and the corresponding CO_2eq emissions, the transport of olives, bulk oil, glass bottles, and bottled oil was taken into consideration, for a 1 litre bottle of EVOO ready to be purchased in a Perugia shop. The environmental transport impact, measured by the emission of CO_2eq, was calculated by adopting a LCA approach, which was applied to all five supply chains examined. The results of the FMs carbon emissions are reported in Table 3.

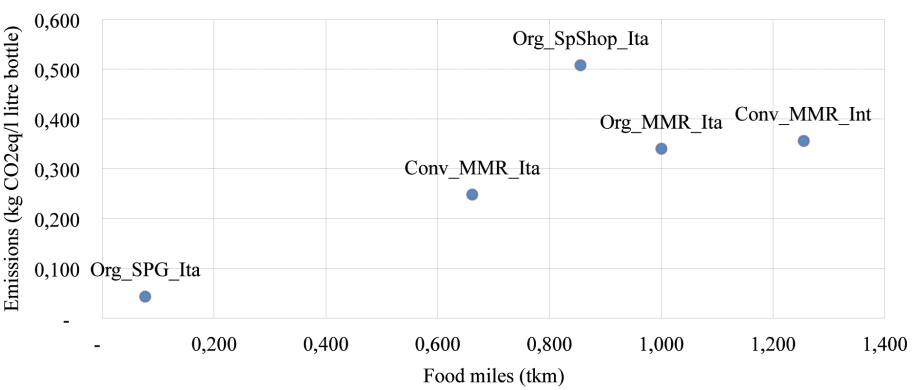
The supply chain with the highest volume of emissions is Org_SpShop_Ita, which emits 0.508 kg of CO_2eq for each bottle of the highest selling price (€ 20/litre). The supply chain with the lowest impact in terms of FMs is Org_SPG_Ita, for the estimated CO_2eq is 0.044 kg. This result underlines the advantages of a short, local supply chain (Org_SPG_Ita), despite the artisanal structures and less efficient means of transport. It should be noted that the Org_MMR_Ita and Conv_MMR_Int supply chains have the same level of emissions: this situation reflects the importance of handling the quantities to achieve greater efficiency from a logistical point of view, within the same organisation. The differences between the various purchasing models are highlighted in Table 3 and in Graphs 1-4. The largest distances travelled are obviously those for cases where the raw material is imported, which, however, do not correspond to the greatest environmental impact in terms of

Table 3 - Food Miles, CO_2eq emissions, selling prices and remuneration of the raw material in the EVOO supply chains

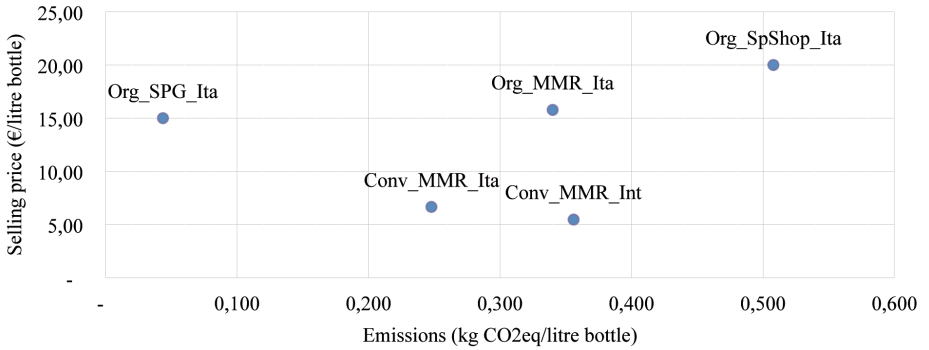
	Unit of measure	Org_SPG Ita	Org_SpShop Ita	Org_MMR Ita	Conv_MMR Ita	Conv_MMR Int
Selling prices	€/1 litre bottle	15.1	20.01	15.80	6.64	5.49
Total distance traveled by means of transport	km	80	875	994	614	2.382
Food miles	tkm	0.077	0.856	1.000	0.662	1.255
CO_2eq emissions	kg CO_2eq/1 litre bottle	0.044	0.508	0.340	0.248	0.356
Remuneration of the raw material	€/1 litre bottle	5,88	5,88	4,7	2,35	1,76

CO_2eq emissions (Graph 1): the rule that lower consumer prices correspond to greater impacts does not apply (Graph 2). The supply chain with the lowest market price for EVOO is Conv_MMR_Int and this chain also has a lower impact than the Org_SpShop_Ita supply chain. In the MMR supply chain, conventional EVOO is not only cheaper than organic olive oil but the chain also exhibits a lower impact. Further, in this case, the raw material with the highest value is obviously the organic olives (Graph 3). Based on FMs, only the Org_SPG_Ita supply chain exhibits a substantial difference from the other chains (Graph 4).

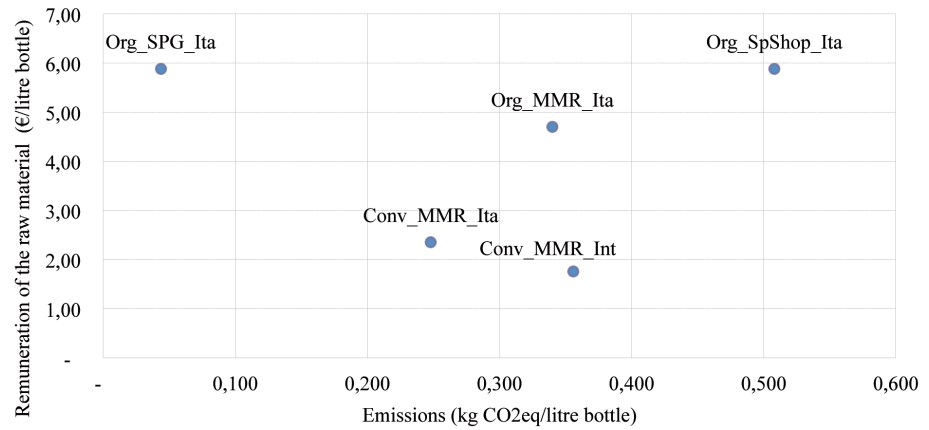
Graph 1 - EVOO supply chains: Comparison of CO_2eq emissions and Food miles



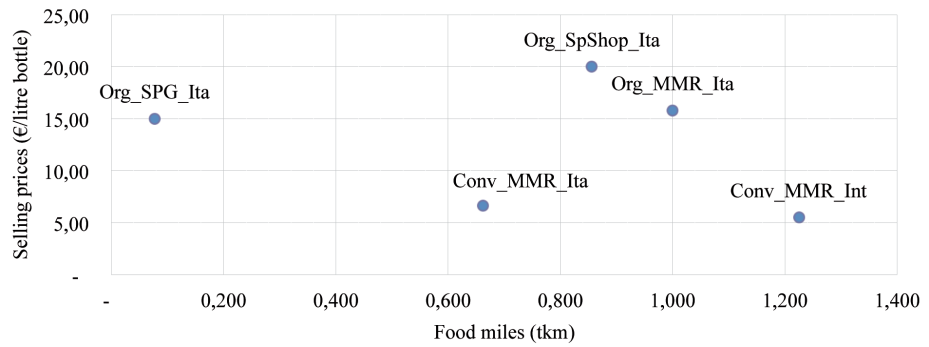
Graph 2 - EVOO supply chains: Comparison of CO_2eq emissions and selling prices



Graph 3 - EVOO supply chains: Comparison of CO_2eq emissions and remuneration for the raw material



Graph 4 - EVOO supply chains: Comparison of Food miles and selling prices



Analysing the environmental impact data, it emerges that the lowest CO_2eq emissions are produced by the short supply chains, despite the widespread use of light commercial vehicles, due to the market fragmentation (into small producers and small retailers). Second, in terms of CO_2eq emissions quantities, are the conventional supply chains with raw materials of Italian origin, whose protagonists are the large agri-food producers and MMR.

The environmental impacts in terms of transport emissions follows the rules of modern logistics, handling large quantities of products. In these supply chains, the impact of transport is lower than that of organic products in long supply chains. These results confirmed the environmental limitation of organic farming in terms of FMs (Franco, 2007).

Despite, the transport issue is only one of the aspects related to the sustainability of a supply chain. In fact, as consumption moves away from places of production, the modes of social and environmental values transmission, typical of organic culture and based on personal relationships and on the construction of local networks, are replaced by institutionalised standards and codification systems (Abitabile, 2015).

To this regard, an excessive proliferation of standards and labels that are not always clear and easily understood by the consumer has been observed (Abitabile, 2015). On the other side, however, empirical evidence underlines the benefits of a label that indicates the environmental effects of transport.

Among others, Akaichi *et al.* (2016) confirm the consumer's willingness to pay a premium price for products that have low GHGs emissions, a reduced number of FMs, and are locally produced. In particular, that study is among the few ones to consider these three attributes simultaneously and show that consumers are much more sensitive to low GHGs emissions than to a reduced number of FMs or local production. In addition, consumers do not seem to perceive the FMs and local production attributes as perfect substitutes.

4. Conclusions

The results of the analysis confirm some general-nature evidence already present in the literature, such as 1) the greater enhancement of agricultural products through short supply chains (Cicatiello *et al.*, 2012a); 2) the association between greater logistical efficiency in terms of impact per t-km and high transport intensity (ISFORT, 2013); 3) the prevalent use of road transport of agri-food products with heavy commercial vehicles for medium distances, and with light commercial vehicles for short distances (ISFORT, 2013); and 4) the existence of intermediate models between the short chain model and the MMR dominant chain model, which can be defined as hybrids (Sonnino, 2009).

The results of this study show that there are differences between the EVOO supply chains in value chains where consumer price plays an important role.

However, combining the value chain results with the environmental impact based on FMs, no real trade-offs, but rather trends, emerge. For example, in organic supply chains, the products with the lowest selling prices generally also have the least impact, while in conventional supply chains a lower selling price is associated with the greatest impact. Organic products, compared to conventional ones, always have higher prices, but exhibit a lower impact in terms of transport only if they are sold in short supply chains. When the sale of organic products occurs in specialised stores, the environmental impact can be even higher than in all other supply chains.

The aim to have accessible consumer prices for organic products has been fulfilled by MMR organic supply chains. They represent supply chains mainly oriented to the market segment in which customers choose organic EVOO for its health benefits but these chains do not pay attention to a fair distribution of AV or to the environmental impacts of transport. Therefore, the Italian organic sector has to counteract the commercial organisation of developed countries on the one hand and the low production costs of emerging countries on the other. The analysis clearly shows the difference between the local organic supply chains and MMR ones.

Several studies (Akaichi *et al.*, 2016; Cecchini *et al.*, 2018; Polenzani *et al.*, 2020) underlined the demand for locally produced food is increasing due to consumers' growing attention towards environmental and social sustainability: these results suggest that the use of environmental information labels could be a product differentiation mechanism and generate more support for sustainable companies.

The wide adoption of such environmental and social voluntary certification schemes turns out to be consistent with the European Green Deal strategy, which aims to create a healthier and more sustainable European Union food system. Further, toward this goal, the Commission intends to propose mandatory harmonised nutrition labelling to be placed on the front of packaging and to develop a framework for labelling sustainable food products that includes their nutritional, climatic, environmental, and social aspects. The environmental results of the empirical analysis demonstrate the possibility of obtaining reliable estimates of transport-related GHGs emissions by using the LCA method on the distribution chain. Moreover, the results show that is possible to link the distance question with that of transport type. The economic results, on the other hand, underline how the spatial proximity between the operators favours a higher producer remuneration, which can have a positive economic impact on the territory, and consequently, on its long-term sustainability. The study of the different

organisational methods of the supply chains made it possible to compare the environmental impact of transport with the allocation of the economic benefits. Despite a few exceptions, it is unequivocal that short and local supply chains, both conventional and organic, can ensure a more equitable distribution of the AV produced among the various parties involved, and a lower environmental impact of the transport of the products.

Far from wanting to extend the results of this study to the entire olive oil sector in Italy, as it focused, in a case study perspective, on 8 families and 15 economic operators, the results achieved could contribute to providing useful indications.

This study has some limitations. Although the chosen bottom-up approach has the typical limits of the case studies method, at the same time, it can generate very detailed information and results.

Moreover, the calculation methodology presents some uncertainties regarding the hypotheses formulated and the recourse, in a few cases, to secondary data, which can generate distortions, and make a comparison with other studies' results difficult.

Finally, the impossibility of interpreting results in a frame of statistical significance limits their external validity and the possibility to extent them to other contexts. On the other side, the wide set of high detailed and accurate primary data collected contributes to increase the internal validity of the analysis with regard to the considered EVOO supply chains.

In this perspective, the obtained results allow us to outline well-defined trends between CO_2eq emissions due to transport and the economic value of the supply chains, which produce useful information for both consumers and policymakers. All of this attains greater importance in the Italian context, where only limited investigation has been conducted to date (Transport and Territory [TRT in Italian], 2006; Blengini & Busto, 2009; Mariani *et al.*, 2011; Cicatiello *et al.*, 2012b; ISFORT, 2013; Torquati *et al.*, 2015; Galli *et al.*, 2015).

As pointed out by Garnett (2011) provide scientific value to the intuitive concepts of FMs and local production, could allow consumers to make informed consumption choices and public decision-makers to develop policies capable of integrating agricultural, environmental, and nutritional objectives (Garnett, 2011). Furthermore, researchers are tasked with studying the local production system in an integrated way, to increase its sustainability from several perspectives (Duram & Obertholtzer, 2010) and to identify the best communication techniques to convey information on the sustainability of agri-food supply chains.

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Food Economy

An International Journal on Agricultural and Food Systems

Vol. 23, Iss. 1, Art. 5, pp. 1-39 - ISSN 1126-1668 - ISSNe 1972-4802
DOI: 10.3280/ecag1-2021oa11549

Mountain beef and wine: Italian consumers' definitions and opinions on the mountain labelling-scheme

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Abstract

Despite the importance of mountain areas and mountain farming, the literature on studies on consumers' opinion concerning mountain food products is not numerous. In order to contribute to filling this gap, this study aims at exploring Italian consumers' opinions regarding beef and wine produced in mountain areas as well as their opinions concerning the new European regulation on mountain food products. To do so, a qualitative approach with observations, focus groups and semi-structured interviews were applied. The results indicate that consumers living in mountain areas and those living in non-mountain areas, including rural areas, have different knowledge about the practices in mountain farming and different opinions concerning mountain food products. Nevertheless, both want mountain food products to be healthier and sustainably produced. Furthermore, they associate wine and beef mainly to credence attributes. As for European regulation, most criticisms are directed to the flexibility of the rules. The inclusion of wine in the mountain quality scheme is not a consensus among consumers. However, the analyses point to the existence of consumers who are interested in wines produced in mountain areas, indicating the emergence of a potential niche market for these wines.

Article info

Type:
Article
Submitted:
11/11/2020
Accepted:
28/02/2021
Available online:
31/05/2021

JEL codes:
Q13, Q18

Keywords:
Mountain food products
Mountain label
Beef
Wine
Consumers' opinions

Managing Editor:
Alessio Cavicchi

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Introduction

Mountains and mountain farming have been in the focus of the European Union since the 1970s, with the implementation of the Less Favoured Areas approach (Bryden & Mantino, 2018; Comission, 2009). The concerns with mountains are not by chance. Mountain areas cover around 18.5% of the total European land surface (Santini *et al.*, 2013) – in Italy, they comprise 43.72% of the municipalities and 58.2% of the national territory (Losavio & Perniciaro, 2017). Roughly, two-thirds of the economic activities in European mountain areas rely on the primary sector, including mountain farming (Santini *et al.*, 2013).

Mountain farming is characterized mainly by family and small-scale agriculture, which plays an important role in supporting sustainability and promoting food security and economic development (European Parliament, 2014; FAO - Food And Agriculture Organization, 2013, 2014; Graeub *et al.*, 2016). These farms tend to be smaller and more diverse in terms of agricultural systems (when compared to large farms). At a larger scale, the combination of these two elements (small-scale and agricultural diversity) contributes to the landscape heterogeneity, thus, protecting biodiversity (Chappell *et al.*, 2013). Moreover, traditional low-intensity farming practices used by many smallholders in mountain areas creates semi-natural habitats such as species-rich grasslands, and grazed wetlands. These habitats contribute to support many species, enhancing biodiversity (Zisenis *et al.*, 2010). In addition, mountain farming is a source of many food products – such as dairy and meat products, wine, fruits, olive oil, among others (Santini *et al.*, 2013) which have a positive image among consumers who tend to associate these products to health and purity, authenticity and simplicity (Giraud & Petit, 2003; Schjøll *et al.*, 2010).

Nevertheless, European mountain areas also face many challenges. The hard living conditions and the regional/global economic dynamics – e.g. harsh climate, increasing production costs, competition with products from other regions – can induce farming exit, contributing to the ageing of farm population and agricultural abandonment (Hinojosa *et al.*, 2016; MacDonald *et al.*, 2000; NORDREGIO, 2004; Terres *et al.*, 2015). Moreover, due to the isolation, the topography, the climate and short growing seasons, mountain farming faces higher production costs compared to lowlands (Reuillon *et al.*, n.d.; Santini *et al.*, 2013).

In order to contribute to the development of rural communities through a "conservation by consumption approach" (Bergmann *et al.*, 2006; Grotelüschen & Requardt, 2006), the European Commission has recently promulgated the Regulation (EU) No 1151/2012 and Commission Delegated Regulation (EU) No 665/2014, creating the conditions for the implementation

of a labelling-scheme for food products intended to human consumption and produced in mountain areas.

However, by defining rules for the use of the quality term "mountain product", the legislation generated both inclusions and exclusions. In other words, not all products from mountain areas are protected by the mountain labelling-scheme. This implies, for example, the exclusion of wines, even though it is an important agricultural product and a tourist attraction in several mountainous areas in Italy, Portugal, Greece, France and Slovenia (Santini *et al.*, 2013). This exclusion also seems to ignore a growing movement from the wine producers' side, who tries to use the mountainous origin to link their products to the positive aspects that mountain food products may evoke to consumers. For example, Figure 1 shows some examples of the association of wines and mountains used by producers across Europe, in an attempt to differentiate their products based on the mountain origin and all that it can represent for consumers". Corroborating this idea, a study with German consumers and producers indicated potential in obtaining a price premium for wine produced in steep slope (Strub & M, 2017). Indeed, associating wines to nature and sustainability could represent an interesting strategy for quality differentiation of wines produced in mountain areas (Schäufele & Hamm, 2017).

Figure 1 - Wine labels from Greece (a), advertisement of a sparkling wine consortium from Italy (b) and announcement of a wine festival dedicated to wines produced in mountains (c)

(a) (b) (c)

Source: Samos Wines (n.d.); Trentino Marketing (n.d.); Federvini (n.d.).

On the other side of the European regulation, there are the products protected by the mountain labelling-scheme. One of these products is beef, which, like wine, is an important agricultural product for many mountain

areas in Europe – e.g. Tyrol (Austria), Massif Central (France). In fact, beef production accounts for 16% of the total turnover of European mountain areas (Santini *et al*., 2013). So, adding value to the mountain beef production using the mountain label may generate a positive impact in the economy of rural areas. Moreover, the use of the mountain labelling-scheme to qualify beef may represent an interesting market opportunity for rural communities, since the market for qualified food products has increased 44% in the sale value between 2010 and 2017, in Europe (EC - European Commission, 2019; Tregear *et al*., 2007).

However, albeit the rules of the mountain labelling scheme may ensure what consumers expect from beef produced in mountain areas, sometimes a label alone may not be powerful enough to become a consumption driver. For instance, in a discrete choice experiment with consumers from Spain and France, the results indicate that the mountain label might have a timid effect on consumers' willingness to pay (WTP) for beef (Sanjuán & Khliji, 2016). In such a situation, using other attributes as moderators may increase consumers' WTP and willingness to consume (Fernández-Ferrín *et al*., 2017; Zanoli *et al*., 2015). Then, identifying these attributes is essential for the development of successful marketing strategies – or even for the improvement of the labelling system.

In spite of such potentialities and considering the importance of wine and beef production for mountain farming, after the entry into force of the regulation on mountain products, few studies involved beef or wine produced on mountain areas. Even so, the vast majority focused on the production side – for instance, Pachoud & Schermer (2019), McMorran *et al.* (2015) and Baritaux *et al.* (2011) – and none of the studies explored consumers' opinion concerning the new regulation on mountain food products.

Against this background, this study aims at exploring Italian consumers' opinions regarding beef and wine produced in mountain areas as well as their opinions concerning the new mountain labelling scheme. To do so, a qualitative approach will be employed in order to answer the following questions: (a) what do consumers expect from wines and beef produced in the mountain areas?; (b) what do consumers think about the rules applied to mountain beef?; and (c) what do consumers think about applying the mountain labelling scheme to wines produced in mountain areas?

1. Background

1.1. *Labelling polices and the mountain labelling-scheme*

Labelling-schemes have become an important policy tool over the last years (Teisl & Roe, 1998). States and supranational organizations develop

labelling-schemes for multiple reasons. According to Lusk (2013), such reasons can be both economic and non-economic. Asymmetric information, quality uncertainty and moral hazard are among the economic motivations for setting up a labelling-scheme. Among non-economic reasons, there are consumers' right for information, protection of specific groups of consumers and producers, paternalistic concerns, externalities and other behaviour-related concerns.

In Europe, the Common Agricultural Policy (CAP) includes labelling-schemes as part of the strategy to support the development of rural areas and the improvement of food quality and health of consumers (Arfini & Bellassen, 2019). The backbone of the European food quality schemes is the Regulation (EU) No 1151/2012 of the European Parliament, the so-called "quality package". This regulation encompasses different labelling-schemes – geographical indications, traditional speciality guaranteed and the optional quality terms for mountain food products and products of island farming – and it offers Member States and producers the general guidelines to apply the labels. With respect to the quality term "mountain product", the regulation aims at: (a) adding value to mountain products in order to compensate mountain producers for higher productions costs; (b) sustaining the farming sector, which is of great importance for the economy of mountain areas; and (c) giving clearer information to consumers concerning the mountain provenance of food products. To do so, the regulation defines the type of products that are suitable to use the quality term "mountain product" as well as the origin of the inputs used and the location of the processing plants (see Table 6 in the Appendix).

In line with Article 2(2) and the first paragraph of Article 31, the quality term is applied only to plant-based, animal and beekeeping products intended for human consumption. Therefore, other types of products, such as cosmetics or handicrafts, which may be common in some mountain areas, are not protected by the mountain labelling-scheme. Wines are also excluded from the list of products suitable of using the quality term, although they are an important agricultural product in many mountain areas in Europe such as South Tyrol (Italy), Douro (Portugal), Haute-Savoie (France) and despite the fact that some countries such as Switzerland apply a similar mountain label to wines. The exclusion of wine (as well as of beer and spirits), is no further explained. Along with the type of products in the first paragraph, there is a specification concerning the location of processing plants. In order to apply the mountain label, processed food products must be processed within the limits of the designated mountain area. The lawmaker's intention seems to be very clear: to preserve jobs in mountainous areas and to prevent these areas from being mere suppliers of raw materials for companies located in other areas by strengthening processing of raw materials and thereby strengthening economic value generation in mountain areas.

Article 31(2) brings the definition of "mountain area" for the purposes of applying the mountain labelling-scheme. For European products, mountain areas are those defined in accordance with Article 18 (1) of Regulation (EC) 1257/1999 - currently Article 32 (1) of Regulation (EU) No 1305/2013 of the European Parliament (see Table 7 in the Appendix). The Italian legislation classifies "mountain area" as such municipalities in which at least 80% of the surface is located higher than 600 meters above sea level or those in which the difference in height between the lower and upper elevations of the municipal area is more than 600 meters (Legge 25 luglio 1952, n. 991 Provvedimenti in Favore dei Territori Montani).

Since the Regulation (EU) No 1151/2012 defines the general guidelines, the paragraphs 3 and 4 of the Article 31 allow the European Commission to adopt delegated acts in order to supplement the article 31(1) of the Regulation (EC) 1151/2012. Based on this, the Commission published the Delegated Regulation (EU) No 665/2014 that defines specific rules on methods of production, raw materials, and feedstuffs.

1.2. *Rules Applied to "Mountain Beef"*

The delegated act specifies three rules applied to beef production in mountain areas. Firstly, animals must be reared for at least the last two-thirds of their lives in mountain areas. In the case of transhumance animals, the minimum time of rearing required is one-quarter of their lives in transhumance grazing on pastures in mountain areas. Secondly, up to 40% of feedstuff are allowed to be produced in other areas. This minimum requirement for feedstuff is again not applied to transhumance animals when reared outside mountain areas. Thirdly, the processing operations – which include slaughtering animals, cutting and boning carcasses – can take place up to 30 kilometres from the administrative border of the mountain area in question.

1.3. *The Application of the European Regulation in Italy*

In Italy, the mountain labelling-scheme is regulated by three decrees of the Ministry of Agricultural, Food and Forestry Policies. The Decree 26 July 2017 (Decreto 26 luglio 2017) – which replicates almost entirely the Commission Delegated Regulation (EU) No 665/2014 – regulates the conditions to use the optional quality term "mountain product". It includes the licensing procedure as well as the ways to control and monitor its use by local and national governments. The Decree of 20 July 2018 (Decreto 20

luglio 2018) details the rules on the origin of feedstuff. Finally, the Decree of 2 August 2018 (Decreto 2 agosto 2018, Istituzione Del Logo Identificativo per l'indicazione Facoltativa Di Qualità "Prodotto Di Montagna") institutes the identification logo for mountain food products (see Figure 2).

Figure 2 - Logo for Italian Mountain Food Products

Source: Italian Decree of August 2, 2018, Launching of the voluntary label "Mountain Product".

1.4. *Wine market regulations*

In Europe, the Regulation (EU) No 1308/2013 of the European Parliament is the main policy prescribing both expenditure and regulatory measures to the markets of agricultural products. Also called Common Market Organization (CMO), the regulation defines many aspects related to labelling and presentation of European wines, giving especial attention to wines under a designation of origin or geographical indications (Pomarici & Sardone, 2020). For instance, the regulation defines the requirements for obtaining the designation of origin, such as the geographical area where the production takes place and the origin of the grapes (Article 93 of the Regulation (EU) No 1308/2013).

European Member States are entitled to implement and expand the rules of the CMO by creating ad hoc regulations. In Italy, the Wine Consolidated Law (Legge 12 dicembre 2016, n. 238, Disciplina Organica della Coltivazione della Vite e della Produzione e del Commercio del Vino, 2016) accomplishes this task concerning wine and viticulture. The Italian law defines rules for the production, marketing, designation and labelling of wines. In the text, there are at least six different designations: protected designation of origin (PDO), protected geographical indication (PGI), geographical indication (IG), controlled and guaranteed designation of origin (DOCG), controlled

designations of origin (DOC), typical geographical indication (IGT). Although both the European regulation and the Italian law weave detailed rules for wine production and labelling, there are no specific rules for viticulture or wines from mountain areas.

Recently, the Italian government published the Decree No 6899, of 30/06/2020 (Decreto No 6899 del 30/06/2020). The objective is to protect and promote the heroic and historic vineyards. According to Article 3 of the Decree, the heroic vineyards are those holding at least one of the following characteristics: land steepness of at least 30%, average altitude above 500 meters above sea level (excluding vineyards located on plateaus), production on terraces or steps, and production on small islands (islands of less than 250km^2). Viticulture in mountain areas encompasses some of these features. For instance, vineyards in steep slopes, high altitudes and/or terraces (Santini *et al.*, 2013). However, the decree does not contemplate all the vineyards located in mountain areas - e.g., the vineyards located between 300 and 499 meters of altitude, which may face the same climatic conditions as the vineyards at 500 meters of altitude. Besides, the rules do not distinguish between vineyards located in mountain areas from those located in islands or at steep slopes in low altitudes.

1.5. *Quality Dimensions and Food Attributes*

Identifying the dimensions of quality and risk that are of importance for Italian consumers regarding wine and beef produced in mountain areas may contribute to the improvement of the mountain labelling-scheme and reinforce consumer protection – as in the case of Parmigiano Reggiano cheese from the mountain (Sidali & Scaramuzzi, 2014). Further, it might support the development of successful marketing strategies for mountain producers – for example, through the transformations of the identified dimensions into quality cues (Northen, 2000).

For consumers, mountain food products hold different attributes (Matscher & Schermer, 2009), that is, distinct dimensions of quality and risk. Quality refers to a perception of certainty about positive expectations, while risk consists of the perception of uncertainty, anticipation about possible negative consequences that may arise from a choice (Volle, 1995).

There is no consensus in the literature as to the number and dimensions in which quality can be broken down (Fandos & Flavián, 2006). For Aurier & Sirieix (2016), food quality can be split into five dimensions: taste and pleasure, health, convenience, social and symbolic, and ethical. On the other side of the coin, these authors name seven dimensions of risk (Aurier & Sirieix, 2016): functional or performance, physical, financial, waste of time, social, psychological, and ethical.

All dimensions of quality and risk that are present in food products are what Lancaster (1966) called good characteristics, meaning something that gives utility to the consumer. Steenkamp (1990), in turn, calls these characteristics "quality attributes" and defines them as the functional and psychological benefits the product provides – or that the consumer perceives as being provided by the product. Generally, these quality attributes can be classified into three categories (Nelson, 1970; Darby & Karni, 1973): search attributes, experience attributes, and credence attributes. *Search attributes* are food characteristics that consumers can verify before purchasing. Examples are price, color, labels, and packaging. *Experience attributes* are those characteristics that can be verified only after the consumption of the product. Flavor, juiciness, texture, convenience in preparation and consumption are some examples of experience attributes. *Credence attributes* are the type of quality attributes that are very hard for consumers to verify, even after consuming the product or using it for a long time. Usually, this type of attributes can only be ascertained by experts or not at all. Most ethical dimensions of quality belong to this category, such as animal welfare, ecological sustainability, social and economic equity but also the origin.

The way consumers perceive these quality attributes is the result of a value judgement in relation to the fitness for consumption (Steenkamp, 1990). In this judgment, consumers assimilate the quality cues in a conscious and/or unconscious way that is influenced by the context and personal traits. The referred cues are, in Steenkamp's definition, informational stimuli related to the quality of the product and can be verified by the consumer prior to consumption. In short, consumers observe quality cues (the information), but actually they want the quality attributes (the functional and psychological benefits). In that respect, quality cues are very similar to the definition of search attributes (Nelson, 1970). With regard to the mountain food products, the production in mountain areas is a credence attribute, because it is not possible to verify for a consumer.

Quality cues can be intrinsic or extrinsic. *Intrinsic quality cues* are intrinsic to the product, which means they cannot be changed without also changing the product itself, its physical characteristics (Olson & Jacoby, 1972). In the case of beef, examples of intrinsic quality cues are taste, color and visible fat. *Extrinsic quality cues*, in turn, are not part of the product although they are connected to it (Olson & Jacoby, 1972). Label, price, brand name, country of origin are examples of wine extrinsic quality cues.

1.6. *Consumer interest in mountain food products*

As stated by Schjøll and colleagues (2010), until 2007, there were only four researches providing pieces of evidence about consumers' interest

in mountain food products. In fact, most of the studies in the literature are related to other aspects of mountain food products – sustainable rural development (Santos, 2017), market potential (Martins & Ferreira, 2017), innovation and tradition in the production process (Pachoud & Schermer, 2019), comparison of the mountain label with other labelling schemes (McMorran *et al*., 2015), application of the mountain label to a supply chain (Bonadonna *et al*., 2015), mountain farming and mountain labelling scheme (Santini *et al*., 2013), producers and retailers opinions about mountain product and the mountain label (Baritaux *et al*., 2011; Bonadonna & Duglio, 2016; Finco *et al*., 2017), production rules and food authenticity (Bentivoglio *et al*., 2019) just to cite a few.

Between 2007 and 2010, the association Euromontana carried out the EUROMarc project, whose objective was to study the market of mountain food products in Europe (Euromontana, 2014). This project analysed consumer interest in mountain products in six countries (Austria, France, Norway, Romania, Scotland, and Slovenia). The research included consumer expectations on food products from mountain areas. Only one study included beef, and none considered wines (Amilien *et al*., 2009).

According to Amilien *et al.* (2009), the results show that consumers expect mountain products to be produced in mountain areas, by small producers, using local raw materials and traditional methods – but observing industrial hygiene standards. Consumers also expect mountain products to contribute to the economy of mountain areas and be associated with the culture and identity of these areas. The authors warn that these expectations vary according to the country and the type of product.

In addition to the EuroMARC project studies, other recent researches have also analysed mountain products from a consumer perspective. In the already mentioned study of Sanjuán and Khliji (2016), the experiment showed that mountain as a place of origin for beef had a low influence on Spanish and French consumer behaviour. In Italy, Zuliani *et al.* (2018), found out that consumers expect mountain dairy products to be healthier than lowland products and produced by small-scale farmers. In Spain, the findings of Resano and Sanjuán (2018) indicated that using the mountain origin for beef positively affected consumer hedonic valuations. In the most recent study (Bentivoglio *et al*., 2020), the results pointed out that consumers' beliefs about the production process and quality attributes of mountain food affected the willingness to pay for milk. The authors also affirmed that health-conscious and local economy-conscious individuals have a higher interest in mountain products.

In summary, the literature shows that we still know very little about what Italian consumers think about mountain food products. To the best we know, there are no researches on Italian consumer opinion regarding beef and wine produced in mountain areas, corroborating the importance of our study.

2. Methods

To answer the outlined research questions, this study used the inductive approach. With this approach, researchers seek to identify frequent patterns in raw data and develop theories from these patterns (Strauss & Corbin, 1998; Thomas, 2006). In this study, this involved triangulating the data collected with different methods to identify emerging categories. We compared the initial results with (a) the European regulation on the mountain labelling scheme, (b) the findings from previous studies on consumers and mountain products, and (c) the concepts on food quality dimensions (Aurier & Sirieix, 2016) and food attributes (Darby & Karni, 1973; Nelson, 1970; Steenkamp, 1990). This process generated the interpretations presented in the results section.

The data collection was carried out using three different methods: observations of the interactions in different occasions between consumers on the one hand and beef and wine producers on the other hand, as well as focus group discussions and semi-structured interviews with beef and wine consumers – Figure 3, in the appendix, summarizes the methodological approach of this study. All three approaches are qualitative. This means that they do not aim at producing quantitative data for statistical comparisons but qualitative data in order to analyse underlying structures of thinking in fields where there is no information available. This means that sample sizes are much smaller compared to quantitative approaches. The three approaches used in this study are closely linked to each other and are explained in more detail in the following.

Observations are generally used in the attempt "to record in a relatively systematic fashion some aspect of the behaviour of people in their ordinary environment" (Banister *et al.*, 1997). In this technique, no interaction between the researcher and the observed individuals takes place. The researcher observes situations and persons to get insights into how people behave (Pope & Mays, 2006). We applied this technique to get first impressions on how consumers react in contact with beef producing farmers and winegrowers and -makers. The objective was to identify words and expressions consumers and producers use to describe wine and beef produced in mountain areas in order to use them for designing the scripts underpinning the subsequent focus group discussions. The observations took place at three different events: an agricultural fair in Bolzano in 2018, where there was a stand of an organic beef producers association from South Tyrol; a festival dedicated to "mountain wine" produced in Trentino and South Tyrol in Trento 2018; and a practitioners' oriented meeting of South Tyrol Wines in Bolzano in 2019. In total, the observation time at the three events was approximately 12 hours. The data collected include a description of the interactions between producers

and consumers and the terms and expressions they used to refer to the product, production process, and the mountain territory.

Based on the results of the observations, the focus group discussions were designed. Focus groups are a method that stimulates interaction between participants (Kitzinger, 2006) and allows researchers to get detailed insights into participants thoughts and arguments about the topic under discussion. Two focus groups were carried out. Thereby, one focused on beef and the other on wine produced in mountain areas. We looked for people over 18 years old and for a varied group of people living in- or outside mountain areas. As an incentive for participation, a 5 Euro voucher from a grocery store specialized in local food products from South Tyrol was offered. The discussions were held in December 2018 in two cities of South Tyrol and a total of 16 people participated. The script of the focus groups included a self-presentation of the participants and an ice-breaker question on their habits concerning beef/wine choices and purchases. These questions were followed by a transition question on the differences between beef/wine produced in mountain and in non-mountain areas. Afterwards, the main questions about attributes and words that participants relate to beef/wine produced in mountain areas were discussed. To close the group discussions, participants were invited to evaluate the activity and to give feedback. During the discussions, further topics popped up such as sustainability in wine and beef production in mountain areas, willingness to pay a price premium for wine and beef produced in mountain areas, the impact of an official mountain label on willingness to consume, and finally opinions regarding the same product type but from geographically different mountain areas. The focus groups were video-recorded and transcribed verbatim, coded and analysed.

Using the preliminary results from the focus groups and observations, two questionnaires for semi-structured interviews – one for each product – were designed. Mixing "closed- and open-ended questions, often accompanied by follow-up why or how questions" (Adams, 2015)the semi-structured interview adds semi-structured interviews more flexibility and makes it possible to investigate topics and ask questions that the researcher could not foresee in advance. The questionnaires were divided into four main parts: 1) consumption habits, 2) beliefs concerning mountain areas and beef/wine produced in mountain areas (including the attributes linked to these products) 3) opinions about the mountain labelling-scheme and 4) participants' demographics. To recruit interviewees, we asked neutral parties – people who were not directly interested in the results of the research, such as researchers from other fields, journalists – to nominate Italian consumers over 18 years old from Lombardy, Tuscany, Trentino and South Tyrol that live in rural or urban areas and are consumers of wine and/or beef. In total, 34 interviews were carried out between February and May 2019. 30 interviews were recorded

and transcribed verbatim, coded and analysed. The notes from the four non-recorded interviews were also used to compare with the results of the other recorded interviews. To determine the number of interviews in this study, we used the theoretical saturation approach. Accordingly, the saturation occurs when no category or new information emerges from data, regardless of the increase in the number of observations (Bowen, 2008). In order to confirm it, Guest and colleagues (2006) suggest the existence of two conditions: (a) a minimum number of observations, ranging from six to twelve; (b) a minimum number of additional observations, that confirm the categories and information found initially, numerically equivalent to at least one-third of the initial observations. All these conditions were observed in this study. Table 1 shows the demographics of the participants of the focus groups and interviews.

Table 1 - Distribution of Participants of the Focus Groups and Interviews*

Gender	Focus Group	Interviews	FG + Interviews
Male	81%	37%	51%
Female	19%	63%	49%
Age			
18-29	44%	3%	16%
30-44	44%	60%	55%
45-59	0%	34%	24%
60+	13%	3%	6%
Place of Origin			
Mountain Area	56%	49%	52%
Non-Mountain Area	44%	51%	48%
Urban Area	81%	54%	61%
Rural Area	19%	46%	39%
Education			
Elementary/High School	44%	23%	30%
University Degree	56%	77%	70%

* Five participants were interviewed for both products and another one participated in both focus groups. Focus group participants were not interviewed and interviewees didn't participate in the focus groups.
** This includes consumers that demonstrated deeper knowledge about the topic of the interview or focus group.
*** Consumers with basic knowledge about beef or wine production.

Although we collected the data using different approaches, we sought to integrate them during the analyses (Halcomb & Andrew, 2005; Lambert & Loiselle, 2008). Following Lambert and Loiselle (2008), we compared the

data in a non-hierarchical way to identify convergences, divergences, and to look for data completeness. This procedure gave us a better understanding of consumer opinions and perceptions about mountain food products and mountain areas.

3. Results

The results are presented in order to highlight the most important findings and answer the questions of the present study. For this reason, no distinction was made between responses obtained in the focus group and those obtained in the interviews because similar topics were discussed.

From the observations, it was possible to extract some terms and narratives used by producers and sellers to present the product to the audience during the events. In the case of wine produced in mountain areas, producers and sommeliers used to mention some aspects such as the more expressive aromas and flavours, the greater need of manual labour, the production in limited quantities, the types of terrain (terraces and steep slopes). Often, these factors were associated with the idea of authenticity: a wine from the mountains would be a product that expresses the terroir of Trento and South Tyrol. In the case of beef, the observation took place with organic farmers from South Tyrol. The producers emphasized the intense contact of the animals with nature. Aspects such as purer mountain air and water, access to pastures or feedstuff produced on the farm. In short, the idea of a more "natural" production was presented as a factor that gave higher quality to meat produced in mountain areas (South Tyrol). This quality was mainly linked to the health dimension: a healthier animal, better nourished and cared for provides healthier meat from the nutritional point of view and with less risk to human health.

Table 2 - Terms and expressions associated to beef and wine produced in mountain areas

Wine	**Beef**
Delicate aromas and flavours	Animals in intense contact with nature
Higher need of manual labour	The purer mountain nature
Terraces and steep slopes	Animals that can graze
Mountain terroir	Animals that eat locally produced feedstuff
	Healthier animals

The results of the observations were used both in the preparation of the interview questionnaires and in the scripts of the focus groups and in the triangulation of the results. Without mentioning the elements in Table 2, the questions were asked in order to verify whether the consumers of the focus group and the interviews expressed themselves in a similar way. Although with some variation, the expressions and terms used by consumers were very similar.

3.1. *Italian Consumers' perceptions of mountain areas and mountain food products*

For Italian consumers, mountains are not all the same. Mountains can evoke different sensations. Thereby, the type of sensation and its intensity may vary according to the consumer who is issuing the opinion and the mountain to which he or she is referring to. The mountain area might have a certain reputation, and this may influence consumers' perceptions regarding the mountain food products coming from this area. For instance, European mountain products are regarded e.g. as more secure and trustworthy compared to other mountain areas, as mentioned by a focus group participant:

I trust more the European mountains than in the Pakistanis ones because I know that in Europe there are quality protocols and rules to be respected, and that is a security for me. (Focus group participant P44 about beef produced in a European mountain or from a mountain elsewhere)

Further, perspectives vary depending on the background of a person. Some consumers were better informed about current farming practices in mountain areas than others. For example, they knew about the co-existence of extensive and intensive breeding in South Tyrol, or the negative effects of monoculture vineyards on biodiversity. These better-informed people currently live in either mountain or non-mountain areas, but they had one thing in common: they have all lived in mountain areas for at least three years in their lives. For this group that we call the 'mountain dwellers' (31 participants, 15 from interviews and 16 from focus groups), mountain areas have problems related to environmental pollution, meaning that nature is not fully preserved. Moreover, they feel that artisanal production has been replaced by industrial models of food production also in mountain areas.

There are few meadows, too many cows. Too much manure. They used to spread [manure on the meadows] in autumn and spring. But now, they do it every day. (Interviewee P11 from South Tyrol commenting on the negative impacts of the livestock farming in Tyrol)

It's an over-fertilization [.] It becomes a problem for the environment, for the water, for everything, for all the insects. There are no more insects. There are few, few insects and for that, there are fewer birds. (Interviewee P3 from South Tyrol commenting on the negative impacts of the livestock farming in Tyrol)

For the 'mountain dwellers', different realities co-exist in mountain areas and they have differentiated pictures in mind. According to them, there are places with preserved nature as well as sites that are contaminated by tailings from agricultural activity. They also see "good" producers and "good" food products as well as "bad" producers and "bad" food products. This means that according to their perception, mountain food products do not guarantee healthier, purer or ethically produced food. Rather, when they want to buy a high-quality mountain food, they go to a farmer or seller they know and trust.

I know a few [farmers]. They all want to do the best [.] They have few animals compared to intensive farming. This changes the way I evaluate [their quality] because I know these facts, right? I'm from this area. (Focus group participant P36 from South Tyrol associating a higher quality to specific farmers she knows and trust)

I often see the trucks with the feedstuff. I see them in the plains and I see them here [in the mountains]. I wonder what the difference is. There's no difference at all. (Interviewee P11 from South Tyrol on the quality of beef produced in mountain area compared to other areas)

In contrast, another group of consumers that are not from and do not live in mountain areas show less critical perceptions. In this group, consumers from Lombardy and Tuscany are included as well as people living in both urban or rural areas. These consumers are less aware of the mountain farming practices or of the environmental conditions in mountain areas. We call this group the 'mountain enthusiasts' (17 participants, all from the interviews). Probably because of the lack of a more intensive experience in mountain areas, the 'mountain enthusiasts' tend to have a positive and idyllic image of mountain areas and mountain food products. They tend to see these areas as places where the environment is still preserved, including the air and water, and animals live in a more natural way. They believe these conditions contribute to produce food products that are healthier and ethically produced.

I connect the mountain to the old days, to the extensive farming, and then I think of free animals to graze. (Interviewee P7 from Lombardy on the type of breeding in mountain areas)

[The animal] is freer, it eats healthier, right?! There's more grazing. It gives me that idea. (Interviewee P17 from the countryside of Tuscany on breeding in mountain areas)

In both groups, 'mountain dwellers' and 'mountain enthusiasts', there are connoisseurs-type and regular-type consumers. The connoisseur is the type of consumer who has demonstrated a deeper knowledge on the topic of the interview or focus group. Usually, he/she is someone who had contact with the subject at the university, took a professional course on the topic or whose profession entails greater contact with the subject (e.g., gastronomic journalist). Or even someone who actively participates in organizations working in the field of agriculture and food production such as Slow Food. 65% of the 'mountain enthusiasts' and 42% of the 'mountain dwellers' can be classified as connoisseurs. In turn, the regular-type is the consumer with basic knowledge of beef and/or wine production. They are unaware of some basic concepts and common terms used in the field of food production. For instance, they barely know one cattle breed. They have very shallow ideas about how the products are made. Respectively, 35% and 48% of 'mountain enthusiasts' and 'mountain dwellers' are regular-type consumers. Although each type of consumer (regular or connoisseur) has a different level of knowledge about meat and wine production, it seemed that the more intense their experience in mountain areas, the less they have an idealized image of such areas. That is to say, regular-type consumers belonging to the 'mountain dwellers' group may have more knowledge on the production of wine and beef in mountain areas than a connoisseurs-type consumer from the 'mountain enthusiast' group.

3.2. *What attributes do consumers relate to wine and beef produced in mountain areas?*

Although having different perceptions about mountain food products, whether consumers are "mountain dwellers" or "mountain enthusiasts", both seem to have similar leaning when it comes to mountain wine and beef. They associate these products, although in different ways, to health and ethical dimensions. The "mountain dwellers" want these products to be healthier and to be ethically produced. The "mountain enthusiasts", in turn, believe these products are already healthy and ethically produced. Health and ethics were not the only dimensions of food quality mentioned. Consumers also referred to sensory and symbolic attributes.

The following tables (Table 3 and 4) summarize the attributes mentioned by consumers and their classification as follows. The first column lists the

attributes that consumers associated with each product. In the second and third columns are, respectively, the overall dimension of quality that the attribute represents and the category to which the attribute is linked derived by Nelson's (1970) and Darby & Karni's (1973) framework.

Table 3 - Attributes related to beef produced in mountain area

Attribute	Quality Dimension	Type of Attribute
Animals grass/hay fed only [a, b, c]	Health	Credence
Antibiotic-free/less-medicine [a, b, c]	Health	Credence
Local/Autochthonous breed only [b, c]	Symbolic (traditional) and Ethical (agrobiodiversity)	Credence
Animals free-range raised	Health and Ethical	Credence
Animals raised [a, b, c] in small farms [b, c]	Ethical	Credence
Animals born and raised in mountain areas [b, c]	Symbolic (identity)	Credence
Animals that live longer [c]	Ethical	Credence
Production supports the local economy [b, c]	Ethical	Credence
Production contributes to preserve the mountain environment [a, b, c]	Ethical	Credence

[a] Results from the observations.
[b] Results from the focus groups.
[c] Results from the interviews.

It is interestingly to note that when referring to the mountain setting all but one attributes are credence characteristics. Specifically, only in the case of wine one experience attribute was mentioned by few connoisseur-type consumers, namely the delicate aromas and flavours of wines produced in mountain areas. These findings confirm the previous study of Steenkamp who found out that most attributes related to wine and beef produced in mountain areas are credence attributes due to their linkage to the ethical and health dimension of food quality (Steenkamp, 1990).

Table 4 - Attributes related to wine produced in mountain area

Attribute	Quality Dimension	Type of Attribute
Delicate aromas and flavours [a, b, c]	Taste and Pleasure	Experience
Grapes from small farms [b, c]	Ethical	Credence
Vineyards located in high altitudes or terraces [a, b, c]	Symbolic (traditional) and Ethical (support mountain communities)	Credence
Wine with less additives [b, c]	Health and Ethical	Credence
Local/Autochthonous grapes only [b, c]	Symbolic (traditional) and Ethical (agrobiodiversity)	Credence
Less mechanization/more manual labour [a, b, c]	Symbolic (identity)	Credence
Limited production [b, c]	Symbolic	Credence
Production contributes to preserve the mountain environment [b, c]	Ethical	Credence

[a] Results from the observations.
[b] Results from the focus groups.
[c] Results from the interviews.

3.3. *Consumers' opinions on the mountain labelling-scheme*

Consumers' opinions on the mountain labelling-scheme are restricted to (a) the definition of mountain areas, (b) the three specific rules applied to beef produced in mountain areas, and (c) the exclusion of wine from the list of products suitable to use the mountain label.

The first outcome of the analysis is that the consumers in our study are unaware of the mountain labelling scheme. Only two consumers knew about the existence of a label for mountain food products. Nevertheless, they were not capable to provide more details on the label nor on the European regulation. In most cases, consumers expressed surprise when they learned about the existence of a specific regulation for mountain products during the discussions and interviews.

A sceptical reaction to the scheme appeared for the first time when consumers were asked to give their opinion on the definition of the mountain area that has been chosen by the legislators in the Regulation (EU) No 1151/2012. The definition, originally from the European regulation on

Less Favoured Areas, is based on the concept of region. This implied the inclusion of both high and low altitudes, the mountain peaks and the bottom of the valleys, within the limits of the mountain areas. However, consumers associate mountains with high altitudes and slope steepness. For them, areas in low altitudes – close to those in high altitudes – should not be considered as mountain areas.

Mountains is where it gets steep. That's kind of the idea people have, isn't it? (Interviewee P30 from Lombardy mentioning the steepness to define mountain areas)

It doesn't even make sense for [the city of] Bolzano to be called a mountain area. (Interviewee P31 of South Tyrol saying that Bolzano, the capital of South Tyrol, located 300 meters above sea level, should not be part of a mountainous area, despite the presence of steep slopes in the city)

With regard to the rule on feedstuff for animals used for beef production, described in the mountain labelling-scheme, opinions vary regardless of the type or origin of the consumer. The mentioned rule requires that at least 60% of feedstuff provided to animals are from the mountain area. The consumers who approved this specification believe that it would be hard to produce all the feedstuff needed because of the climatic and environmental conditions in mountain areas – reduced arable land surface and shorter growing seasons. Some of them think that an increase in feedstuff crops would generate negative effects on plant biodiversity in mountain areas. For other respondents, who rejected the flexibility of the feed rule, the negative impact on the environment could come from importing feedstuff from other areas. According to them, this would generate heavy vehicle traffic and greenhouse gas emissions. In addition, they said that the quality control of imported feed would be complex. For instance, it would be hard to ensure healthy feedstuff for animals. For the consumers who reproached the feedstuff rule, an increase in the percentage of locally produced feed is seen as an improvement. But some of them also suggested a beef production based only on animals fed exclusively on grass or hay.

The specifications concerning the location of the slaughterhouse, the origin and the minimum rearing time of animals in mountain areas did not generate conflicting opinions among consumers. On the one hand, the location of the slaughterhouse does not seem to be an issue. The rule establishing that processing plants must be located within 30 km from the administrative limits of the mountain area has not generated controversy or disagreement.

Even when it was shown to the participants that processing plants for dairy products must be closer (10 km from the limits of the mountain zone) than slaughterhouses, no contrary reaction was outlined by the interviewees. Actually, the only strong response came from an interviewee who mentioned that the processing plants could be located even in another region, away from the mountain area.

I don't see any difference if [the slaughterhouse] is in another area. For me [the location of the slaughterhouse] is not a certificate of the mountain origin. But the place where the animal lives is. (Interviewee P18 from Lombardy on the rule about the location of the slaughterhouse)

On the other hand, consumers reacted negatively in relation to the rule on the origin and time spent by the animals in mountain areas. For them, an authentic mountain beef should only be produced from animals born and raised entirely in mountain areas. The only exception would be for transhumance animals who are already treated differently in the mountain labelling-scheme. Consumers accept the fact that these animals could live some time outside mountain areas according to the tradition of this type of farming.

I don't expect the calf to be bought in France, in Marseille, and taken to South Tyrol. I expect its whole life to be in the mountains. (Interviewee P19 from Lombardy commenting the rule on the origin and time animals spend in mountain areas)

The exclusion of wine from products suitable to use the mountain label divided the interviewees. The arguments in favour of the exclusion included the excess of labels and terminologies used by the wine sector and the perception that wine is not a typical mountain product. The comments in favour highlighted the importance of protecting all kinds of food products from mountain areas and the consumers' right for information regarding the origin of the product. Some participants of the focus group affirmed that they would be more interested in knowing the altitude of the vineyard rather than its location in a mountain area. Table 5 sums up the consumers' opinions on the mountain labelling-scheme.

Table 5 - Consumers' opinion on the mountain labelling-scheme

Criteria/Rule	Consumers' Opinions
Definition of mountain area	Consumers find the rule inappropriate. The definition is based on the concept of region, including low and high altitudes. Consumers tend to associate mountain areas to high altitudes.
Livestock feedstuff for beef production – minimum of 60% produced in mountain areas	Opinions of consumers who agreed: it is hard to produce all the feedstuff needed in mountain areas; increasing crops for animal nutrition would affect plant biodiversity.
	Opinions of consumers who disagreed: importing feedstuff would increase the environmental footprint; it is hard to check the quality of imported feedstuff.
	Suggestions from consumers who disagree: increase the minimum percentage of locally produced feedstuff; produce beef exclusively from animals grass/hay-fed only.
Origin of animals and Minimum rearing time of animals in mountain area – non-transhumant animal: at least 2/3 of their lives; transhumant animals: at least 1/4 of their lives in mountain areas	Consumers disagree with the specification for non-transhumant animals.
	Suggestion: non-transhumant animals should be born and raised in mountain areas.
	The exception for transhumance animals is acceptable.
Exclusion of wine from the list of products suitable to use the mountain label	Opinions of consumers in favour of the exclusion: there are already too many labels and terminologies for wines; wine is not seen as mountain product.
	Opinions of consumers in favour of the exclusion: all mountain food products should be protected by the mountain labelling-scheme; the more information, the better for consumers.

4. Discussion

Overall, the results show that consumers don't necessarily have a positive representation of mountain food products and mountain areas. As showed in the previous section, participants who live in mountain areas seemed to be aware of the current mountain farming practices and the negative impacts it may cause in mountain areas. These results are different from the literature (Amilien *et al.*, 2009; Santini *et al.*, 2013; Schjøll *et al.*, 2010), according to which consumers tend to associate mountains and mountains areas with positive aspects. In our study, people not living in mountain areas, whether from urban or rural areas, had such positive representation.

Albeit these different representations of mountain areas and its food products, consumer expectations about mountain products indicate a higher interest for healthier and ethical products and a strong association of these products with credence attributes. The only exception was one sensory attribute associated with wine. Overall, the results of our study are in line with previous research (Amilien *et al.*, 2009; Schjøll *et al.*, 2010; Zuliani *et al.*, 2018).

Our results also indicate some divergences between consumer interest in mountain products and the quality standards of the European and Italian rules. These gaps occur in two ways. On the one hand, the attributes pointed out by consumers are not protected by the standards. None of the attributes associated with beef is included in the European regulation on mountain products. As for wines, the Italian legislation on historic and heroic wines addresses two of the attributes that respondents of our samples associated with mountain wines (production on terraces and at high altitudes).

On the other hand, consumers criticized some of the rules of the mountain labelling scheme. Firstly, the definition of mountain areas seems inappropriate for some consumers. The inclusion of the surrounding lowlands inside the administrative limits of mountains areas differs from the view of consumers for whom mountains are associated with high altitudes. This situation may cause a feeling of fraud for consumers and affect their trust in the label because the information displayed seem inaccurate or false in relation to the origin of the product (Connelly *et al.*, 2011). Consumers' distrust of the mountain labelling-scheme may have major implications such as negatively influencing purchase intentions (Teng & Wang, 2015). One possible solution could be the adoption of two definitions, the mountain area and the mountain region – as it is the case in the Swiss legislation (*Conséil Fédéral Suisse*, 2020). The mountain region is defined broader and includes the mountain areas/zones although they are located in the lowlands. This would imply a transformation of the quality term from "mountain product" into "product of mountain region", highlighting that the product came from a region with mountains. Additionally, it would be interesting to "territorialize" the mountain area. In other words, linking a product from the mountain with the name of the region or of the mountain range to which it belongs would be a sound strategy in terms of consumer protection. This would also help consumers to better identify products since mountains are not all the same and the place of origin is perceived differently by individuals. Also, from a marketing point of view, giving the product more of a personalized image and attach it to an existing image of a mountain area may strengthen its emotional value for consumers. This might add value and increase the interaction with the product (Thomson *et al.*, 2005; van Ittersum *et al.*, 2003).

Secondly, some issues emerged regarding mountain beef. For instance, the possibility of using feedstuff from other regions and the rules on the origin and time the animals stay in the mountain areas have succumbed to criticism related to ecological sustainability, (human) health and the perceived authenticity of beef from mountain areas. The study of McMorran and colleagues (2015) corroborate such criticisms, in particular, those associated with the absence of sustainability-related rules in the mountain labelling system.

In short, the central problem in both cases is the mismatch between the rules "exchange of rules" (Fligstein, 2008) – the quality standards determined by the European and the Italian legislation – and the characteristics (quality dimensions) desired by consumers. In such a scenario, the market may become unstable or even disappear (Akerlof, 1970).

Interestingly, the rule on the location of the processing plants did not cause controversies. However, considering that the mountain labelling scheme is part of a rural development policy strategy for mountain areas, keeping the location of processing plants close or within mountain areas would trigger work opportunities for mountain dwellers and add value to their food products. In a nutshell, this would contribute to the achievement of the policy goals.

Although our goal in this qualitative study is not to produce a statistically significant sample, the low number of people who knew of the label is of note. A similar problem occurs with geographical indications in Europe (London Economics, 2008). The lack of public awareness campaigns may explain part of the low awareness. However, we also have to consider that the legislation is recent – the European regulation is from 2012 and the Italian legislation from 2018.

Finally, the wine world, already very segmented and complex, is probably witnessing what could be considered the birth of a new niche market (Kemp *et al*., 1998): the mountain wine market. As in the market of specialty coffees in Brazil (Souza, 2006), the construction of institutions for the recognition of this new market, with its inclusion in the list of products suitable to use the mountain label, and the consequent definition of the characteristics of this product, may contribute to consolidation of this new market in Europe.

5. Conclusions

In this study, we sought to explore Italian consumer opinions regarding (a) beef and wine produced in mountain areas, and (b) their opinions concerning the new European mountain labelling scheme.

Undoubtedly, the European labelling scheme for mountain food products represents a major breakthrough supporting the development of mountain communities. Defining products and conditions under which producers can use the quality indication "mountain product" potentially contributes to make information available for consumers and to develop a successful niche market. It can contribute to avoiding free-riders – that is, producers who associate non-mountainous products with mountainous areas, using images and expressions that refer back to the mountain to market their products –, preventing consumers from being misled and producers from being harmed by unfair competition. In addition, it may help mountain producers to add value to their products through the association of the food product to a territorial origin scheme – the "mountain area".

Nevertheless, like any innovation – in this case, an institutional innovation – some improvements may be necessary to ensure the long-term success of the mountain labelling-scheme. First, policymakers should evaluate the adoption of two different definitions for mountain areas: one wider and one more restrictive. The latter would only include the territory located above a minimum altitude – for example, above 400 or 500 metres above sea level, depending on latitude. For the other strategies and objectives of rural development policies, the current broader definition of mountain areas would remain valid. Second, the authors recommended the adoption of existing control mechanisms – such as a criteria for livestock densities, pasture management and fertiliser usage in eligibility measures for Less Favoured Areas payments – as a way to increase sustainability while trying to reduce the exclusion of producers due to costs, stringency and lack of applicability that may arise from the application of sustainability-related rules. Third, policymakers should include the quality term "mountain product" among the possible designations for wines in the CMO rules and in the Italian Wine Consolidated Law to support winemakers from mountain areas and add value to their products.

6. Limitations and Future Research

Considering that this study collected data only from Italian consumers regarding beef and wine, the results and conclusions must be applied with caution to other countries and/or products. Future research including consumers from different Italian regions, from different countries and/or other representatives of the food supply chain would contribute to enriching the studies on mountain products. In addition, quantitative research should be carried out to confirm some of the findings of this study.

Moreover, since we collected the data months before the publication of the Italian legislation on heroic viticulture, future research could also analysis consumer opinions regarding this. Hence, further research is needed to highlight the potential of mountain food products as a mountain development strategy.

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Appendix

Table 6 - Regulation (EC) 1151/2012 – Articles 2 and 31

Article 2
Scope

1. This Regulation covers agricultural products intended for human consumption listed in Annex I to the Treaty and other agricultural products and foodstuffs listed in Annex I to this Regulation.
In order to take into account international commitments or new production methods or material, the Commission shall be empowered to adopt delegated acts, in accordance with Article 56, supplementing the list of products set out in Annex I to this Regulation. Such products shall be closely linked to agricultural products or to the rural economy.

2. This Regulation shall not apply to spirit drinks, aromatized wines or grapevine products as defined in Annex XIb to Regulation (EC) No 1234/2007, with the exception of wine-vinegars.

3. This Regulation shall apply without prejudice to other specific Union provisions relating to the placing of products on the market and, in particular, to the single common organization of the markets, and to food labelling.

4. Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on Information Society services (21) shall not apply to the quality schemes established by this Regulation.

Article 31
Mountain product

1. The term 'mountain product' is established as an optional quality term.
This term shall only be used to describe products intended for human consumption listed in Annex I to the Treaty in respect of which:
(a) both the raw materials and the feedstuffs for farm animals come essentially from mountain areas;
(b) in the case of processed products, the processing also takes place in mountain areas.

2. For the purposes of this Article, mountain areas within the Union are those delimited pursuant to Article 18(1) of Regulation (EC) No 1257/1999. For third-country products, mountain areas include areas officially designated as mountain areas by the third country or that meet criteria equivalent to those set out in Article 18(1) of Regulation (EC) No 1257/1999.

3. In duly justified cases and in order to take into account natural constraints affecting agricultural production in mountain areas, the Commission shall be empowered to adopt delegated acts, in accordance with Article 56, laying down

derogations from the conditions of use referred to in paragraph 1 of this Article. In particular, the Commission shall be empowered to adopt a delegated act laying down the conditions under which raw materials or feedstuffs are permitted to come from outside the mountain areas, the conditions under which the processing of products is permitted to take place outside of the mountain areas in a geographical area to be defined, and the definition of that geographical area.

4. In order to take into account natural constraints affecting agricultural production in mountain areas, the Commission shall be empowered to adopt delegated acts, in accordance with Article 56, concerning the establishment of the methods of production, and other criteria relevant for the application of the optional quality term established in paragraph 1 of this Article.

Table 7 - Definition of Mountain Areas - Regulation (EU) 1305/2013

Article 32
Designation of areas facing natural and other specific constraints

1. Member States shall, on the basis of paragraphs 2, 3 and 4, designate areas eligible for payments provided for in Article 31 under the following categories:
(a) mountain areas;
(b) areas, other than mountain areas, facing significant natural constraints; and
(c) other areas affected by specific constraints.

2. In order to be eligible for payments under Article 31, mountain areas shall be characterized by a considerable limitation of the possibilities for using the land and by an appreciable increase in production costs due to:
(a) the existence, because of altitude, of very difficult climatic conditions, the effect of which is to substantially shorten the growing season;
(b) at a lower altitude, the presence over the greater part of the area in question of slopes too steep for the use of machinery or requiring the use of very expensive special equipment, or a combination of these two factors, where the constraints resulting from each taken separately are less acute but the combination of the two gives rise to an equivalent constraints.

Areas north of the 62nd parallel and certain adjacent areas shall be considered to be mountain areas.

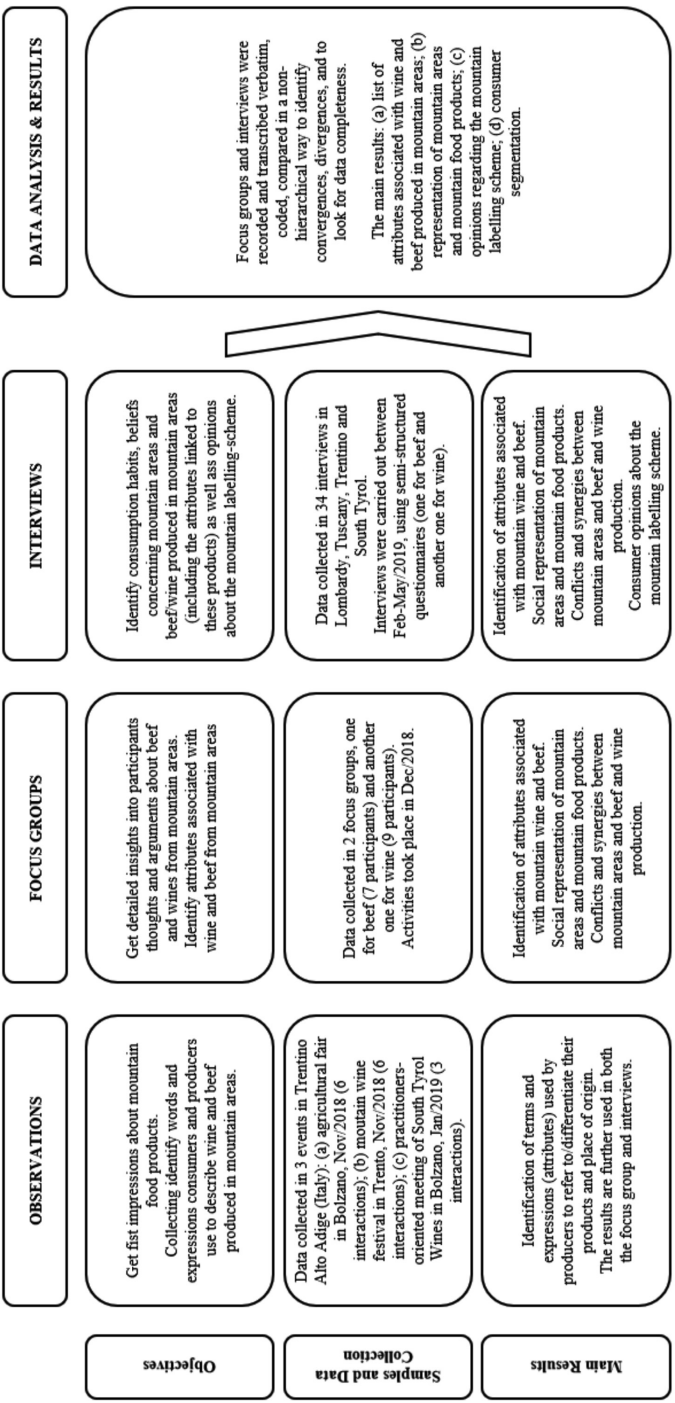

Figure 3 - Description of methods, results and data analysis

Focus Group – Script

1. Introduction: 10 min

Self-presentation of the participants and of the chairperson. Explanation of the rules of the focus group.

2. Icebreaker: 15 min

How do you choose your beef/wine?
Which are the most important characteristics when you are choosing beef/wine?
Where do you get information about the beef/wine you chose?

3. Transition question: 15 min

Is there any difference between the beef/wine produced in the mountains and the other beefs/wines?

4. Main discussion: 30 min

Which are the most important characteristics of mountain beef/wine?
How would you describe a mountain beef?
Which attributes cannot be changed in order to preserve your opinion about the mountain beef/wine?

5. Closing and Evaluation: 10 min

How was the activity?
What did you like the most?
What would you change?

Semi-Structured Interview – Questionnaire – Beef

1. How many times did you eat beef last week?
2. How important is beef, compared to other meat, in your diet?
3. Over the last year, what happened to your consumption of beef?
4. Where do you usually buy beef?
5. In which situations do you usually eat beef? (e.g., on the weekend, special meals, daily)
6. How do you choose your beef? Do you choose the type of beef before going shopping or while shopping?
7. Do you think the beef you buy is locally produced? How do you know?
8. Which are the most important characteristics when you are choosing beef?
9. How do you identify these characteristics?
10. Where do you get information about the beef you chose?
11. Do you think that there is any difference between the beef produced in the mountains and other beefs?

12. How would you describe a beef produced in a mountain area? Which are the most important characteristics of beef produced in mountain areas (including the product itself and production system)?
13. Do you think beef produced in South Tyrol meets this description? Why?
14. For a beef to be considered an authentic product of mountains, how should it be? How should it be produced?
15. Recently, the European Commission established rules for labelling products of mountain areas in order to differentiate them from other products. It created a label to certify beef that can be considered an authentic mountain product. The rules for an authentic mountain beef are the following:
    a) Animals must live at least the last 2/3 of their lives in mountain areas.
    b) In case of transhumant animals, they must be reared for at least 1/4 of their life in transhumance grazing on pastures in mountain areas.
    c) If it is not possible to produce locally all the animal feedstuff, farmers are allowed to buy feedstuff from other areas. In this case, the proportion of feedstuff not produced in mountain areas must not exceed 40% of the total amount of feedstuff.
    d) The slaughtering of animals, sectioning and boning of carcasses must be done in processing plants located no more than 30 km from the administrative border of the mountain area.

    Do you think these rules are enough to certify a beef as a mountain product? Why? What would you add/change?

Semi-Structured Interview – Questionnaire – Wine

1. How many times did you drink wine last week?
2. In which situations do you usually drink wine
3. In which situation did you drink wine for the last two times?
4. Over the last year, what happened to your consumption of wine?
5. Where do you usually buy wine?
6. How do you choose your wine? Could you describe the situation when you are buying wine, the questions you make to the salesperson, what you look for at first place, etc.?
7. In average, how much do you spend on a bottle of wine?
8. Do you usually choose the same wine or wine region, or do you like to try different wines?
9. Which are the most important characteristics when you are choosing wine?
10. How do you identify these characteristics?

11. Where do you get information about the wine you choose?
12. Is there any difference between the wine produced in the mountains and wines produced in lowlands?
13. How would you describe a wine produced in a mountain area? Which are the most important characteristics of wines produced in mountain areas (including the product itself and production system)?
14. Do you think a wine from South Tyrol (or other mountain region) meets that description? Why?
15. For a wine to be considered a real product of the mountains, how should it be? How should it be produced?
16. Recently, the European Commission established rules for labelling products of mountain areas in order to differentiate them from other products. The European commission excluded wines (and other beverages) from the list of mountain products. Do you agree with this? Why?

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Economia agro-alimentare /
Food Economy

An International Journal on Agricultural and Food Systems

Vol. 23, Iss. 1, Art. 6, pp. 1-11 - ISSN 1126-1668 - ISSNe 1972-4802
DOI: 10.3280/ecag1-2021oa11350

Is an alternative to private property durable in agriculture?

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Abstract

The desire for sustainability calls for new development paths for the agricultural sector. Some suggest creating small to medium size farms, performing agricultural practices that preserve ecosystems, are labour intensive and connected to local markets. New farmers are a necessity in many rural areas, yet the main obstacle to the settlement of newcomers is access to land. This research suggests an alternative to private property of land, such as experienced by the Foncière Solidaire created by the association «Terre de Liens» in France, which collectively buys land (13,500 shareholders, end of 2019) to lease them to new farmers under long-term basis. The research question is therefore: "Is this alternative to private property of land durable?" Here, durability means the permanence of farms, despite the on-going upheavals. We suggest that the values are the key, and that values leading to everlastingness describe a conception of Justice. To identify whether or not the values describe a conception of Justice in practice, the discourses should be consistent with the six axioms of the Grammar of Justice by Boltanski and Thévenot (1991) when implemented to a Local Common Good (Thévenot, 1993). The whole movement cannot last without the association Terre de Liens being permanent itself. We will highlight that the discourse (official communication) of the Terre de Liens association calls on Justice, being consistent with the six axioms. We

Article info

Type:
Note
Submitted:
24/08/2020
Accepted:
01/12/2020
Available online:
31/05/2021

JEL codes:
Q13, Q56

Keywords:
Private property
New comers
Access to land
Collective property

Managing Editor:
Maurizio Canavari

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also underpin that the main challenges are the evolution of regulations, and especially the European laws and French annual financial laws, which set the rules for fiscal exonerations and drive agricultural practices. Whatever these evolutions, it is likely that the association would achieve permanence because of the high number of actors (communes searching for farmers, applicants to taking or transferring farms, donors, shareholders) who are federated around its "Fair" raison d'être. Yes, there is a potential for durable alternative to land private property in agriculture.

Introduction

European agriculture has been losing jobs since the end of the Second World War, and farm numbers are continuously decreasing. The average annual rate of decline between 2005 and 2013 stood at 2% for the EU-27, but is slowing down in the older Member States (EU-15: –0.9% per year). The overall decrease in the number of farms is mainly linked to expansion, which for a long time seemed to be the only way to save farmers. Indeed, only large farms were profitable (in purely financial terms) in response to the constant political and regulatory pressure in favour of industrialised agriculture based on mass production (Rioufol, 2020). This agro-industrial model seems to be triumphant everywhere. Yet many indicators are demonstrating its limits. The effects of expansion are well-known in rural areas: drastic reduction in the number of agricultural workers, desertification of the countryside, disappearance of services to the population, advance of wastelands, risk of fires, etc. Today, social requirements for sustainability (rejection of pesticides, deforestation etc. (Ricci *et al.*, 2018) and new biophysical threats to agriculture (crop loss due to climate change) are challenging the agro-industrial model. So, alternative development paths for agriculture are needed.

To replace agro-industrial agriculture, two new models are being developed. The first does not renounce mass production, and advocates for so-called agro-ecological practices. These assume that farmers design their production systems (e.g. crop diversification and extension of rotations, establishment of hedges) based on the functionalities offered by ecosystems, while reducing pressures on biodiversity (Alim'Agri, 2013; Caquet *et al.*, 2019). The second model renounces mass production in favour of agricultural or food products that are distinguished by their qualities (Appellation of Controlled Origin, Protected Geographical Indication, organic farming

products etc.). Both alternative agricultures can be practiced on smallholdings (market gardening, small fruits, orchards, small livestock) or medium farms (traditional livestock, cereals, seeds, oils), applying agricultural practices that preserve ecosystems, labour-intensive and connected to local markets. Some new business models already running (e.g. selling through AMAP[1]), but setting up new farmers is a necessity. Indeed, the transformation will never be fast enough if we count on current farmers only. For instance in 2017, land under organic farming represents between 0.2% (in Malta) to 23% (Austria) of the cropland, i.e. on average 7% of Member States' croplands (EU, 2019).

The agro-ecological or organic model make it possible to densify the rural population, renovate buildings and provide decent jobs for new agricultural workers, while almost 16 million Europeans are unemployed (Eurostat, 2019). Multiple trials show that these alternative models work and continue to work, yet the new comers are not numerous enough. In Europe, Monllor and Fuller (2016) demonstrated that the newcomers are in average 26 years old, with higher education, one half from urban background, the other half from rural one, the proportion of male and female being balanced. They are seeking to develop business models based on pluriativity and multifunctionality. The main obstacles they face are firstly access to land, and also access to capital and market (Monllor and Fuller, 2016). Proposals for the rental of residential and operational buildings and associated land are rare. Agricultural land prices are very uneven in Europe, and it is impossible for many prospective settlers to buy a farm.

In this case, it is worthwhile to propose alternatives that make it possible to establish newcomers under long-term leases, without imposing the burden of land ownership on them. On the ground, the alternative systems are collective ownership of land, by collecting funding from shareholders, acquiring land and leasing the farms to new farmers. Are these alternative systems durable? Indeed, aren't they victims of the "tragedy of the Commons" (Harding, 1968) already denounced by Aristotle[2]? The purpose of this paper is to contribute to the discussion, based on the case study of a French associative system of collective ownership of agricultural land. The "Foncière Solidaire", created by the "Terre de Liens" (TDL) association in France, collectively buys land (13,500 shareholders, end of 2019) to lease them to new farmers on a long-term basis. The initial research question is therefore "In the TDL case study, is the system of collective property durable?".

1. An AMAP means "Association pour le Maintien d'une Agricultuer Paysanne", and is an association of consumers bound to a local producer by an agreement providing for bulk delivery of vegetables.

2. Aristotle «What is common to all is cared for less, because people are more interested in what is theirs than what they have in common with their peers».

1. Materials and methods

Investigation method

To study the case of the "Terre de Liens" association (TDL) and its associated pillars the "Foncière solidaire" and the "Foundation", from a durability perspective, several methods can be envisioned, depending on the meaning given to "durable".

First, the meaning of durability can be "sustainability" as used in the famous Brundtland report (Brundtland, 1987). But it is not at all the meaning given in this paper, because the relevant question is effectively the perennity of the system over time. The question is not if the system provides more positive externalities in terms of environmental, social, cultural or other issues than a conventional alternative. These are totally different issues. Indeed, a system can provide positive externalities without lasting and, at the contrary, certain systems last without providing positive externalities.

Second, in English, the meaning of durability can be "that lasts, that persists over time". Applied to an organization, lasting means – to put it bluntly – that its activities will continue over time, for example beyond 35 years (Mignon, 1998). This is precisely the meaning that is used in this paper. One first method would be to find whether the collective property system effectively lasts or not over time. Unfortunately, in the case of TDL (which is one of the oldest initiatives of collective ownership of land in Europe), the institutions to make collective ownership possible are young, as they were created in 2006 and 2013. There is therefore a lack of hindsight in estimating the long-term lasting of the system. Nevertheless, there is another method to assess not the effective perenity, but the potential for perennity of an organization, through the features of its values. In such a perspective, the effective research question becomes: "In the TDL case study, has the system of collective property the features of durable companies?".

To do so, we rely on works on the perennity of companies. The meaning of "durability" is taken here from the point of view of the likelihood of organization survival, despite the current upheavals. It questions the survival of TDL itself as an association, since the movement as a whole cannot last without it (explained below). In accordance with the seminal works by Collins and Porras (1994) and Mignon (1998) about survival of firms, we suggest that the values are the key, and that values leading to survival describe a certain concept of Justice (Macombe, 2003). In other words, the values of the organization leading to perennity are compliant with a conception of Justice. Yet, several conceptions of Justice are possible (Walser, 1983; Boltanski and Thévenot, 1991). But all of them follow the same rules, which have been identified and formalized by Boltanski and Thévenot (1991) under the name of "Grammar of Justice". In practice, the rationale leading to

survival are values expressing a certain conception of Justice, which is itself consistent with the six axioms of the Grammar of Justice by Boltanski and Thévenot (1991) when applied to a Local Common Good (Thévenot, 1993). For instance, the local common good can be "an environmentally friendly agriculture" or somewhere else "an exporting agriculture", or "a particular endangered cow breed".

To identify the values of TDL, we will seek calls for justice in the rationale (official communication) of the TDL association, which are in relationship with the six axioms (either affirming the axiom, or denying it). The sentences relating to subjects other than values are not selected. We analyzed all the texts presented on the TDL website (including the movement's charter) according to the grid provided by the Grammar of Justice of Boltanski and Thevenot (1991). The Grammar of Justice axioms are as follows: (a1) There is a common humanity; (a2) There are different states among people, and they are not stable; (a3) All the states are accessible to anybody; (a4) There is an order among the states: The Grands who contribute to the Common Good, and the Petits, who do not; (a5) To become Grand, there is a necessary effort; (a6) There is a Common Good which benefits all (Petits and Grands) whatever their contribution.

Presentation of the case

The TDL association was created in 2003, out of the desire of several French actors (from popular education, organic and biodynamic agriculture, ethical finance, solidarity economy and rural development) to influence the evolution of agriculture. It has helped many neo-rurals (more than 1,000 in 2019) get established since 2003. Noting the difficulty of would-be new farmers, TDL created the "Foncière Solidaire" (a social and solidarity economy company, a limited partnership with variable capital shares, 81 million euro at the 31st of December 2019) at the end of 2006, and in 2013 a "Foundation" recognized as a public utility (which mainly receives farms as donations and legacies, capital is 1.9 million euro in 2019). These two institutions purchase the land on which a would-be farmer is bidding, and lease it according to the status of the environmental rural lease (which guarantees ecological practices), in the long term. For the "Foncière", the funds come from joint and several shareholders who are natural or legal persons under private law. The "Foncière" also collects employee savings funds and institutional savings bank funds (e.g. Caisse des Dépôts et Consignations). Altogether, TDL, the Foncière Solidaire and the Foundation include 78 employees and 900 volunteers.

75% of the funds are used to collectively purchase the land, while 25% remain on the reserve to reimburse shareholders who wish to withdraw. When a candidate for installation has located land, his file is examined by

TDL. In case of acceptance (80% of cases), TDL launches a public subscription to buy the domain in question. To date, TDL has created 207 farms, out of 5,500 ha that belong collectively to the "Foncière Solidaire" and/or the "Foundation". The type of farms that can benefit from this scheme was clarified in 2018. They must respect the following four criteria: the values of the TDL charter, the specifications of organic farming, the values of the smallholding charter, and develop mainly food production (Annual Report, Assemblée générale Foncière Solidaire, 2018). Farmers set up with the help of TDL form a network, supported by local actors (about 100 volunteers devoted to this task in France), which increases farm survival (Bloch *et al.*, 2012). The "Foncière" undertakes never to resell any of the land acquired, and systematically seeks a buyer in the event of the termination or departure of the farmer in place. It should be noted that TDL also provides legal support for management, and communication (classifieds site) for the many local authorities who are looking for candidates to settle on their own land. In 2019, ad traffic (land demand/disposition) represents three to five ads per day.

2. Results and discussion

We present an extract of the verbatim from TDL while deliberately using the same vocabulary as TDL, although many terms would require discussion or definition.

If the extract comes from the TDL charter, this is mentioned. All other excerpts are taken directly from the TDL website.

It appears that TDL recognizes a common humanity of citizens (axiom a1) in relation to the agricultural issue, and that land is the common good that benefits all, because it ensures the food sovereignty of populations (axiom a6). There are several "states" linked to different types of farms and people who favour either the agro-industrial model or the opposite local agricultural model (axiom a2). These states are ordered: the Grands are those who fight against speculation, and stop the disappearance and destruction of farms; different kinds of Petits are those who speculate or support agro-industrial agriculture (axiom a4). Citizens can access all states (i.e. support any of the models). In particular, TDL has invented mechanisms that allow everyone to support the local agricultural model (axiom a3). Accessing the state of Grand (supporting local agriculture) requires personal investment (training to become voluntary, lucid, responsible, autonomous, capable), and the provision of farms is a "long process" (axiom a5). The six axioms of the Grammar of Justice are therefore clearly stated by the TDL movement. In accordance with the work on perennity of organizations mentioned above (Collins and Porras, 1994; Mignon, 1998; Macombe, 2003), we can conclude that from a values

Table 1 - Axioms of the Grammar of Justice and verbatim illustrations from the website of TDL *(December 2019)*

No.	Name of the axiom	Extracts
A1	There is a common humanity	"It wishes to enable **everyone** to exercise their responsibility [-] towards the land that they consider [-] as a common good" (charter). "Enable **citizens**, individually and collectively, to exercise their responsibility with regard to the use of their land, particularly in the agricultural and food sectors" (charter).
A2	There are different states among people, and they are not stable	"More than 200 farms quit their business every week in France, particularly in favour of **ever larger agro-industrial farms**". "Local agriculture, through its local roots, is at the heart of this dynamic: it is based on **farms on a human scale** and makes it possible to build relationships between citizens and farmers who produce our food".
A3	All the states are accessible to all	"These tools are **within everyone's reach**, so that **everyone** can become effectively involved in the future of our farms and agriculture". "**Popular education**: creating conditions for volunteers to act [-]" (charter)
A4	There is an order among the states: The Grands who contribute to the Common Good, and the Petits, who do not	TDL was created to "**free the land** from land and real estate **speculation** [-], support **environmentally friendly** agriculture" (website and charter). "This land is definitively emerging from the **speculative market**, is guaranteed to be maintained in the long term in its agricultural vocation and is ready to welcome new farmers with farming practices that respect the soil and the environment". "More seriously, a small number of farms continue to expand by **taking up land resources, to the detriment** of young farmers who are discouraged by the difficulties of setting up". "Give meaning to your money by focusing on its exchange value, encourage transparency and **combat speculation**" (charter). "Favour **setting** up new farmers over **expansions**" (charter). "Stop the **disappearance and destruction** of agricultural land" (charter).
A5	To become Grand, there is a necessary effort	"To create conditions for volunteers to be able to act [-] in a **lucid, responsible and autonomous manner** and to participate in the social transformation towards a freer and more just society" (charter). "The purchase of a farm is a **long process** in several stages: monitoring and identification of opportunities, valuation of assets, project appraisal, financial arrangements, legal and administrative arrangements for transactions".
A6	There is a Common Good which benefits to all (Petits and Grands) whatever their contribution	"To consider the land as a **living and inalienable common** good to ensure the **food sovereignty** of the populations" (charter). "The land that they consider [-] as a **common good**" (charter). "Without agricultural land, there can be no **peasants** or **local agriculture** that respects the **environment** and creates **links**".

perspective, TDL presents a rationale that is compatible with the durability over time of its activities. In the TDL case study, the system of collective property has the features of durable companies.

What are the challenges for the association? Looking back over TDL's history shows that governance issues are well addressed over time and with experience. The result is a fairly complex system for the layperson, but transparent (there is a diagram on the website) for managing and monitoring of all activities. On the other hand, the number of employees remains modest because many tasks are carried out by volunteers. However, specialisation (e.g. tax) and the growth of activities require new hiring. Through the activity reports of the "Foncière Solidaire" and the "Foundation", it is clear that the constant fluctuation of legal provisions on the regulation of shareholding, donations, and especially on taxation (possible tax exemptions) that apply to shareholders are permanent subjects of concern. The rules concerning the nature of the savings that can be raised, the limits on annual subscription, the ceiling and the rate of tax exemptions, are challenged almost every year, threatening the "Foncière Solidaire's" land acquisition model (through public savings calls). In response, TDL adapts its underwriting rules annually, and carries out ongoing lobbying work with French parliamentarians, directly and through its members. As long as the influence of TDL and the other French Solidarity Owners associations concerns a marginal fraction of the land released each year, they do not disturb the powerful interests of real estate or land speculation. The land targeted by TDL is too small to be of interest to investment funds (average of 23 ha per farm, i.e. 13 ha per farmer TDL while the average size is 36 ha per farmer in France). Yet, the movement is growing (with other initiatives also, see de Haas, 2007), and could come up against a regulatory and fiscal "wall". However, despite a probable slowdown in acquisitions, TDL is set to continue its assistance to local authorities and its spin-offs to other French and foreign structures.

TDL must be able to stay on course in this complex and changing institutional environment. Having a robust and coherent theory of justice is a definite asset in finding one's way in this context.

3. Conclusions

Is an alternative to private property of agricultural land durable, or are these alternatives always victims of the "Tragedy of Commons"? The contribution of this paper is not about the effective long-term lasting of the TDL system (indeed, there is a lack of hindsight in estimating the long-term lasting of the system), but about to know whether the values of TDL display the specific features of durable companies. Our brief investigation concludes

that, from a values perspective, TDL presents a rationale that is compatible with the durability over time of its activities. Of course, it is not possible to conclude that TDL itself will effectively last over time, nor will reproduce in sister organizations with the same purpose. Indeed, Belgium, Germany, the United Kingdom, Spain, Italy and Lithuania are developing similar structures as TDL (Rioufol, 2020). The formula of the "Foncière Solidaire" and the "Foundation" seems likely to develop strongly, as long as the legislator allows them to do so. Since 2012, TDL animates the network "Access to Land" of 15 European sister organizations, with the purpose of launching similar initiatives especially in Eastern Europe, to develop organic and agro-ecological agriculture. "Access to Land" lobbies the European Commission to influence regulations about agriculture practices and land tenure.

TDL not only organizes the preservation of agricultural land, but also anticipates the generalization of crop/livestock systems that consume less inputs and are more labour-intensive, which will likely become more widespread in the future. Also, TDL's way of working could be a model pathway towards forests protection, which seems to be less developed in France to date (despite some trials like the "groupement forestier citoyen du chat sauvage", in the Morvan region). There is therefore a potential for durable collective alternatives to individual ownership of agricultural land, the future extent of which depends on future policy decisions.

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Economia agro-alimentare /
Food Economy

An International Journal on Agricultural and Food Systems

Vol. 23, Iss. 1, Art. 7, pp. 1-18 - ISSN 1126-1668 - ISSNe 1972-4802
DOI: 10.3280/ecag1-2021oa11676

Agri-food trade and climate change

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Abstract

Climate change, the agri-food sector and trade are closely related. This contribution aims at presenting issues related to the economic impacts of climate changes on international trade. The agri-food sector is one of the most hit by changes in climate, and it is also responsible of substantial environmental impacts. In a globalised world, these effects do not alter only the agri-food domestic markets but propagate across countries. While climate change may trigger changes in trade patterns by altering food availability and access as well as comparative advantages across countries, trade itself may constitute an adaptation strategy. Our note provides elements to be considered in the future debate that will likely be focused on the interrelations between, climate change, trade and global value chains of agri-food products.

Article info

Type:
Notes
Submitted:
07/12/2020
Accepted:
24/03/2021
Available online:
31/05/2021

JEL codes:
F18, Q17, Q54

Keywords:
Adaptation
Development
Global value chain
Trade

Managing Editor:
Maurizio Canavari

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Introduction

Climate change, agriculture, food systems and trade are intimately interrelated (McCarl and Hertel, 2018). Climate change may cause uncertainty due to short-run shocks and long-run changes in weather conditions. Climate-induced uncertainty poses a threat to the agricultural sector (Briamonte *et al.*, 2020). In addition, the proliferation of extreme weather events (e.g. floods, heat stress, droughts) are responsible of crop yield losses and failures, crop quality reduction, and impacts on livestock with consequences on the global food system (Mrabet *et al.*, 2020).

To cope with the bad consequences that may emerge, the agricultural sector needs to adapt to climate change to reduce greenhouse gas (GHG) emissions and continue to evolve to meet a growing global food demand (FAO, 2018). Among other changes, the adaptation to climate change may involve shifts in patterns of international trade (Baldos and Hertel, 2015) and imply new trade dynamics that may reinforce the efforts made in the agri-food sector to mitigate the impacts. How does climate change affect trade? It seems well established that it alters the comparative advantage and competitiveness of sectors across countries, thus making relatively less or more profitable to trade with new (or other) trade partners (Costinot *et al.*, 2016; Gouel and Laborde, 2021).

The role of connection between economies makes trade a key factor to adapt to challenges posed by climate change, such as food security and availability (FAO, 2018). However, trade may be both beneficial and detrimental. Grossman and Krueger (1993) suggest that trade produces three effects. First, while international trade creates additional output, it also increases resource depletion and pollution with negative effects on climate change (i.e. scale effect). Second, international trade may influence the sectoral composition of economies with climate change impacts that may be either positive or negative depending on whether an economy has a comparative advantage in emission-saving or emission-intensive sectors (i.e. composition effect). Third, international trade may induce technology spillovers reducing the emission per unit of output produced or consumed and improving environmental quality (i.e. technique effect).

Our contribution provides a cursory review of the state of the art of the literature on the linkages between agri-food trade, global value chains and climate change. We discuss on the economic impact of changes in climate – both short-run and long-run – and linger on the importance of considering climatic trends and climatic distances in trade dynamics. Lastly, we provide elements that should be taken into account in the future debate on the interrelations between climate change and trade of agri-food products.

1. Climate change from an economic perspective

Climate change is a phenomenon affecting any regions of the world and producing, for instance, global warming and changes in precipitations patterns. As argued by the Intergovernmental Panel on Climate Change (IPCC), climate change has strong impacts on incomes and economic activities, although heterogeneous across countries (IPCC, 2014). Among economic activities, agriculture is one of the most negatively affected by climate change but also a main driver of changes in climate. In sections 1.1 and 1.2 we discuss on the relationship between climate change and economic development and on the dual linkage between climate change and the agricultural sector.

1.1. *Climate change and development*

Climate change stands for the long-run changes – increases or decreases – in climate, defined as the average weather conditions such as temperature and precipitation, among others (Dallmann, 2019). Mendelshon *et al.* (1994) define the 'normal' climatic variables as the 30-year average of each climate variable (e.g. temperature, precipitation).

Figure 1 summarises country-specific changes in average temperature and precipitation over a period of 55 years[1]. For each country, we compared the mean annual levels of temperature and precipitation[2] in the first three decades of the sample (1961-1987) and in the last three decades of the sample (1988-2016). Descriptive statistics indicates the long-run differences across the two periods. Data show that, on average, the world has become, in a period of about fifty years, about 1 °C warmer, as it has been well- documented in the literature (e.g. Dell *et al.*, 2012). Figures also suggest a potential relationship between the changes in temperature and the level of countries' development[3]. In fact, developed economies – often high-latitude countries – tend to report an increase in temperature greater than 1 °C between the periods 1961-1987 and 1988-2016: a few examples are European countries and Canada. While the differences among countries with the highest increases and the lowest

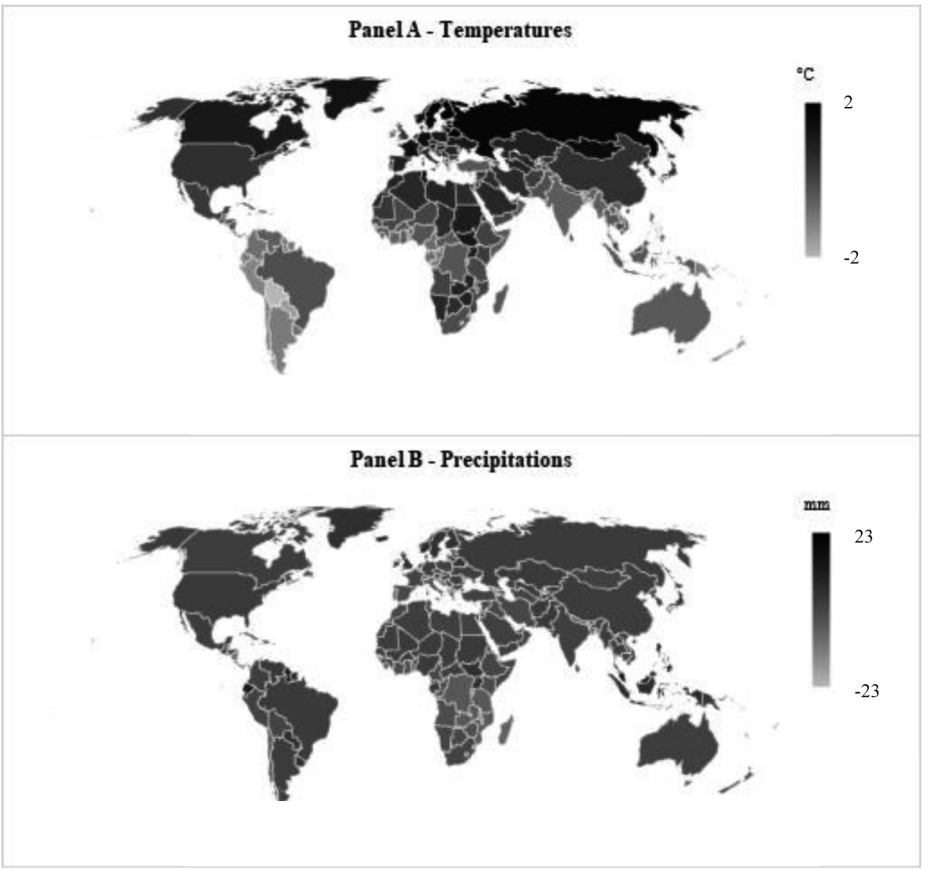
1. Data cover the period between 1961 and 2016 and are from the Climate Change Knowledge Portal, which provides historical average temperatures (in °C) and precipitations (in mm) for each month at the country level.

2. The mean annual levels of temperature and precipitation are obtained as averages of monthly values for each country.

3. Countries have been classified in developed and less developed economies according to the recent classification proposed by the United Nations (2020).

decreases in average temperature is about 1.4 °C, the average precipitation is more volatile with a variation within countries (5.5 mm) that is significantly higher than the average increase that is observed between the two periods (0.3 mm). The data also show a substantial variability in average precipitation between 1961-1987 and 1988-2016 across countries, more marked in less developed countries. If the effects of human activities are locally stronger, the relationship just mentioned is likely to be there: validating this connection is important to better understand how climate change may alter the global agri-food sector.

Figure 1 - Differences in average temperatures and precipitations between 1961-1987 and 1988-2016



	All	Developed	Less developed
Temperatures (°C)			
Mean	0.7	1.0	0.6
Std. dev.	0.3	0.3	0.2
Max-min variation	1.4	1.1	1.3
Precipitations (mm)			
Mean	0.3	1.3	0.1
Std. dev.	5.5	2.8	6.0
Max-min variation	42.1	12.8	42.1

Source: elaboration on data from Climate Change Knowledge Portal.

Note: differences at the country level are obtained by comparing the mean annual levels of temperature and precipitation in 1961-1987 and in 1988-2016. Countries has been classified in developed and less developed economies following the United Nations classification (2020).

The long tradition of climatic theories of development dates back to 1915 when Ellsworth Huntington wrote about "*Civilization and Climate*". Acemoglu *et al.* (2002) support the 'geography hypothesis' and argue that geographic, climatic, or ecological dissimilarities across countries explain most of the differences in economic development. Sachs (2003) demonstrates that economic dimensions (e.g. per capita income, economic growth) are strongly correlated with geographical and ecological variables such as climate zones. Also, the impacts of extreme weather events may differ depending on countries' income distribution (Miljkovic and Miljkovic, 2014). While climate may affect development, development itself may lead to different responses to changes in climate. Adaptation potential and adaptation capability to climate change are highly dependent on the level of development and may exacerbate inequalities in the economic growth between countries (Reilly and Hohmann, 1993). Limited variations in the economic growth of more developed countries – more likely to adapt – can cause large changes in less developed countries – less likely to adapt – (Fagereng *et al.*, 2016).

1.2. *Climate change and agriculture*

Changes in climate, both short-run shocks (i.e. weather variations) and long-run changes, have the potential to impact economic activities. Climate changes alter productivity thus production costs as well as resource availability and market prices, with consequences on welfare, poverty, and food security (McCarl and Hertel, 2018). Changes in climate and agriculture

are tied up together. While the agricultural sector is one of the most hit by changes in climate (e.g. Deschenes and Greenstone, 2007, Mendelsohn and Massetti, 2017), it is responsible of great environmental impacts (Tricase *et al*., 2018). Agricultural activities (e.g. intensive livestock, fertilisation, land use and management) are important contributors of greenhouse gas (GHG) emissions with related consequences in terms of climate changes (Santeramo *et al*., 2020a).

On the demand side, a growing population and changes in diet is causing an increase in demand for food and for livestock feed (Fukase and Martin, 2016). Consequently, emissions from agriculture are expected to increase (Mrabet *et al*., 2020). The challenge for the agricultural sector is to achieve an equilibrium between adaptation to climate changes and sustainable intensification of agriculture (FAO, 2018).

On the supply side, climate changes may have substantial impacts on world production growth (Martin, 2018). Climate is an input for the agricultural production, thus changes in climate may affect prices and supply of agricultural outputs (Dellmann, 2019). Changes in climate have both direct and indirect impacts on crop yields (Mrabet *et al*., 2020). Increases in temperature tend to be detrimental for crop yields, with low-latitude countries being the most negatively affected (e.g. McCarl *et al*., 2008). Indeed, low-latitude countries may have less potential to adapt; for instance, they are generally characterised by warmer climate and may have difficulties in producing crops that perform better in climates still warmer (Reilly and Hohmann, 1993). The indirect effects of changes in climate on crop yields are mainly related to increases in the cost of inputs and of factor productivity (McCarl and Hertel, 2018), but effects due to land use changes should be not neglected (Santeramo and Searle, 2019; Santeramo *et al*., 2020b). Climate changes also affect the livestock sector: impacts are evident, for instance, on milk production (Key and Sneeringer, 2014), disease and parasites (Mu *et al*., 2013), feed intake and feed supplies (e.g. Mader 2014).

Overall, the impacts of climate changes on the demand-supply balances in the agricultural sector are related both to direct losses (e.g. crop failures) and several indirect effects triggered by market reactions to events occurring in other producing regions of the world (Chatzopoulos *et al*., 2020).

2. On the effects on Trade and Global Value Chains

Impacts of climate change on the agricultural sector led producers to alter their activities to reduce adverse impacts or exploit opportunities, thus adapting to evolving climatic conditions. Agricultural activities may be altered also in an effort to mitigate emissions, the main cause of climate

change (McCarl and Hertel, 2018). Impacts of climate change and adaptation and mitigation strategies may be reflected also in trade patterns.

The literature on the impacts of changes in climate tends to consider agricultural domestic markets, leaving underinvestigated the effects on world production, markets, and trade patterns (Reilly and Hohmann, 1993). However, the production of agriculture and food products is more and more globally interconnected: the global value chains[4] (GVCs), which involve both developing and developed countries, are replacing the domestic value chains (Hernández et al., 2014). This emerging trend implies that countries are not isolated but linked through socio-economic and geopolitical interdependences (Santeramo and Lamonaca, 2019), and the impacts of climate changes on agricultural domestic markets may propagate at the international level, especially through trade. However, participation in the GVCs is heterogenous, with countries serving as resource-based economies and others providing their specialisation to manufacturing (Taglioni and Winkler, 2016). The differences in participation to the GVCs are mainly due to a persistent heterogeneity in trade costs (Hoeckman, 2014), which matter the most when trade patterns change.

Trade may help achieving the ambitious mitigation strategies set by the Paris Agreement[5]; it impacts climate either through the emissions of the transport industry, or by favouring (or disfavouring) emissions-saving productions (Hertel, 2018). Climate is a major exogenous input in agri-food production, and a potential source of absolute or comparative advantage. Moreover, climatic differences may explain, and even motivate, bilateral trade among *climatic distant* countries, which therefore differ in terms of comparative advantages (Santeramo *et al.*, 2021). Changes in climate may directly impact trade by modifying comparative advantages[6] (Costinot *et al.*, 2016; Gouel and Laborde, 2021), or indirectly impact it by legitimating trade as an adaptation strategy to climate change (Burke and Emerick, 2016). Put differently, climate changes alter global trade dynamics, and exchange terms in bilateral trade.

The relationship between climate and trade has traditionally been quantified using two approaches (Table 1). One approach, based on panel methodologies and reduced form equations, examines the effects of weather variations on sectoral and/or national output, productivity, international trade

4. Trade in agricultural products often involves global value chains, with commodities produced in any countries and processed in other countries (Hoeckman, 2014).

5. The Paris Agreement target global warming to be below 1.5 °C.

6. Changes in climate may alter comparative advantage, i.e. the relative ability of a country to produce a certain product (and export the excess of production) as compared to its trade partners.

Table 1 - Relationships between trade and climate: evidence from literature

Reference	Case study	Model	Climatic phenomenon	Impacts
Impacts of weather variation on trade				
Gassebner *et al.* (*Rev. Int. Econ.*, 2010)	170 countries	Gravity model	Climatic disaster	An additional climatic disaster reduces imports by 0.2% and exports by 0.1%
Oh and Reuveny (*Global Env. Change*, 2010)	116 countries	Gravity model	Climatic disaster	An additional climatic disaster in importer or exporter countries reduces imports by 2.68% and 0.59%, respectively
Jones and Olken (*Am. Econ. Rev.*, 2010)	World exports to the United States	Empirical model	Weather variations	An additional degree Celsius reduces the export growth rate by 2.0-2.4% from all countries and by 3.8-5.7% from poor countries
Li *et al.* (*Econ. Letters*, 2015)	China	Empirical model	Weather variations	Exports decline by 8.8% per degree Celsius rise and increase by 1.6-2.0% with 100 mm higher precipitation
Dallmann (*Env. Res, Econ.*, 2019)	134 countries	Empirical model	Weather variations	Bilateral trade reduces by 3.1% with an additional degree Celsius in exporter and by 2.1% with an increase in difference of temperatures between exporter and importer
Dall'Erba *et al.* (*Am. J. Agric. Econ.*, 2021)	Countries of the United States	Gravity model Ricardian model	Severe drought	Trade is expected to act as a 14.5 billion USD adaptation measure
Impacts of climate change on trade				
Reilly and Hohmann (*Am. Econ. Rev.*, 1993)	United States, Canada, European Community, Australia, Argentina, Thailand, China, Brazil, the former Soviet Union, Sweden, Finland, Norway, Austria, Switzerland, Japan, Rest of World	Equilibrium model	Climate change	Net global welfare changes are between 115-190 billion USD with carbon dioxide fertilisation effect and between 7-25

Table 1 - Continued

Reference	Case study	Model	Climatic phenomenon	Impacts
Rosenzweig and Parry (*Nature*, 1994)	Global analysis	Equilibrium model	Climate change	With trade liberalisation, production reduced by 11-20% without direct CO_2 effects on yields and by 0-5% with adaptation
Randhir and Hertel (*Agr. Res. Econ. Rev.*, 2000)	Canada, United States, Mexico, European Union, China, ASEAN, Australia, and Rest of World	Equilibrium model	Climate change	Trade liberalisation increases the global welfare gain from climate change (6,855 million USD) if the tariffication of trade policies is accompanied by substantial reductions in farm support
Costinot *et al.* (*J. Pol. Econ.*, 2016)	Global analysis	Equilibrium model	Climate change	Global GDP reduces by 0.26% whit adjustment in trade and production patterns
Gouel and Laborde (*Env. Econ. Mang.*, 2021)	Global analysis	Equilibrium model	Climate change	Production and trade adjustment reduce global welfare losses by 55% and 43%, respectively

(e.g. Dell *et al.*, 2012; Dellmann, 2019), as described in section 2.1. The second approach, presented in section 2.2, relies both on macro and micro evidence to simulate the effects of climate change in scenarios with and without trade adjustments (e.g. Costinot *et al.*, 2016; Gouel and Laborde, 2021).

2.1. *Impacts of weather variation on trade*

A recent strand of literature examines the impacts of weather variations on international trade. As argued in Jones and Olken (2010), international trade may provide more accurate information on sectors of countries' economic activities affected by climatic changes. A niche of this literature analyses the effects of natural disasters on trade (e.g. Gassebner *et al.*, 2010; Oh and Reuveny, 2010) suggesting that a higher incidence of natural disasters is detrimental for bilateral trade: Gassebner *et al.* (2010) suggest that an additional climatic disaster reduces imports by 0.2% and exports by 0.1%, whereas Oh and Reuveny (2010) conclude that imports decrease by 2.68% and 0.59% if a climatic disaster occurs, respectively, in the importer or exporter countries (Table 1).

By examining the impacts of climate shocks on international trade in China, Li *et al.* (2015) find an impact of increases in temperatures and rainfall levels (i.e., exports decline by 8.8% per degree Celsius rise and increase by 1.6-2.0% with 100 mm higher precipitation) and compute high welfare losses induced by weather variations. Jones and Olken (2010) quantify the impacts of temperature shocks on exports in a panel regression framework and reach two main findings: impacts of weather shocks are sector-specific and differ according to countries' economic development (Table 1). Consistent with a long-standing climate-economy literature (e.g. Dell *et al.*, 2012), findings of Jones and Olken (2010) highlight a substantial impact on agricultural exports. In addition, while temperature shocks seem to have no effect on high-income countries, impacts of higher temperatures are detrimental for low-income countries, whose exports reduce by an amount ranging between 3.8% and 5.7% for each degree Celsius increase. Heterogeneity in the impacts of weather variations across sectors and level of economic development is also found in Dallmann (2019). However, his conclusions contrast with findings of Jones and Olken (2010). The sector-specific analysis of Dallmann (2019), in fact, reports a significant positive impact of higher temperatures on the agricultural trade and no effect of precipitations. He also finds no differentiated impacts of temperature shocks on exports of low-income countries. A value added of the analysis by Dallmann (2019) is the evaluation of cross-border effects of climate changes.

By examining the relationship between the weather of trade partners, he finds that bilateral trade reduces for each additional degree Celsius increase in differences between the exporter and importer temperatures (-2.1%), but differences in levels of precipitation between trade partners do not have effects on bilateral trade (Table 1). A recent article by Dall'Erba *et al*. (2021) reveals that bilateral trade is impacted by severe drought: droughts occurring in the exporter lower its export capacity, but the impact is not as relevant as the trade creation effect resulting from droughts occurring in the importer. They suggest that trade is expected to act as a 14.5 billion USD adaptation measure.

Overall, the literature suggests there are marked impacts of temperature shocks and limited effects of variations in rainfall levels[7]. Mixed evidence characterising the relationship between temperatures and trade may be explained by the fact that the effects are observed in the short-run and no information are provided on their persistence through time. Long-term analyses may be more informative on the effects of climate changes on international trade and how trade adapt to changes in climate.

2.2. *Impacts of climate change on trade*

The linkage between international trade and climate change adaptation in the agricultural sector has been investigated mainly with partial equilibrium or general equilibrium models. Assuming that impacts of climate change on agricultural domestic markets cannot be considered in isolation from the rest of the world, Reilly and Hohmann (1993) and Rosenzweig and Parry (1994) suggest that climate-induced changes in the agricultural production may be shaped by international trade (Table 1). Reilly and Hohmann (1993) conclude that interregional adjustments in production and consumption buffer the severity of climate change impacts both at global and domestic level. They found that net global welfare changes are between 115-190 billion USD with carbon dioxide fertilisation effect and between 7-25 billion USD with adaptation. Rosenzweig and Parry (1994) suggest that doubling of the atmospheric carbon dioxide concentration would lead to only a small decrease in global agricultural production, when adjustments in trade flows are not constrained: indeed, with trade liberalisation, production reduced by 11-20% without direct CO_2 effects on yields and by 0-5% with adaptation. Randhir and Hertel (2000) assess the potential interaction between climate change and agricultural trade policies and find that, with agricultural

7. Such evidence is confirmed by the erratic correlation between exports and short-run precipitations (see Figure A.1, panel B in the Appendix).

subsidies, increased price transmission reduces global welfare in the wake of climate change. They conclude that trade liberalisation would increase the global welfare gain from climate change (6,855 million USD) if the tariffication of trade policies is accompanied by substantial reductions in farm support (Table 1). More recent studies by Costinot *et al.* (2016) and Gouel and Laborde (2021) assume that if impacts of climate changes on productivity differ between regions, then adjustments through trade patterns may dampen the adverse effects of climate changes. Costinot *et al.* (2016) quantify gains from adaptation to climate change through changes in production and trade patterns. They find larger welfare losses from climate change (–0.26% in global GDP) when trade and production patterns can adjust. Similarly, Gouel and Laborde (2021) examine the role of trade in attenuating effects of climate change through new climate-induced pattern of comparative advantages. Differently from Costinot *et al.* (2016), they conclude that climate-induced welfare losses are greater when adjustments in trade flows are constrained versus when they are not: production and trade adjustment reduce global welfare losses by 55% and 43%, respectively (Table 1).

Evidence from literature are mixed and potentially reflect divergences across countries. All in all, the dual contribution of trade in mitigating the effects of climate change and fostering adaptation to climate change – limited (Costinot *et al.*, 2016) *versus* crucial (Gouel and Laborde, 2021) – is not surprising. In fact, as climate change alters the comparative advantage and competitiveness of agriculture across countries, some countries could lose while others could gain (FAO, 2018). Less developed countries start with a disadvantage (Reilly and Hohmann, 1993) and measures of adaptation to climate change seem to play a limited role in reducing inequalities between developed and developing countries (Rosenzweig and Parry, 1994). Very far from being conclusive, the research on the effects of climate change on trade and on the GVCs should be promoted and intensified.

3. Conclusions

Climate changes is a central issue for agriculture. Some effects, already observed, are likely to intensify in the future, contributing to declines in agricultural production, fluctuations in world market prices, growing levels of food insecurity (Reilly and Hohmann, 1993; Briamonte *et al.*, 2020). These effects are also likely to be detrimental in some countries and positive in others with potential impacts on their economic development. Agriculture in low latitude countries – often developing economies –, already suffering from poverty and food insecurity, could be negatively affected. High latitude countries – often developed economies –, characterised by

temperate climates, could observe positive effects on agriculture with warmer weather (FAO, 2018). Uneven impacts of climate changes across countries and consequent changes in food availability and access as well as in comparative advantages are likely to affect international trade patterns (Baldos and Hertel, 2015; Martin, 2018; Santeramo *et al.*, 2021). By allowing the reallocation of food from surplus to deficit regions, agricultural trade has the potential to lowering inequalities between regions with different levels of economic development, helping countries adapt to climate change. It is of utmost importance to find adaptation and mitigation solutions to climate change in agriculture and food systems to face and combat food insecurity (Mrabet *et al.*, 2020). These solutions may involve actions to reduce net emissions from agriculture and food production, for instance by modifying management practices (e.g., manure management, use of fossil fuel and nitrogen fertiliser), by increasing carbon sequestration (e.g., avoiding deforestation or land conversion), by producing substitutes for emission-intensive products (e.g., bioenergy, wood).

For these reasons, in recent years, the relationships between agriculture, trade, GVCs, and climate change have been at the forefront in trade and development policy agendas of different agreements. In fact, one of the aims of the 2030 Agenda for Sustainable Development, of the 17 Sustainable Development Goals (SDGs), and of the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) is to support developing countries, to promote a sustainable development and the provision of agri-food produce, by intensifying climate change adaptation and mitigation efforts. The return of the United States in the Paris Agreement would strengthen the global cooperation towards the achievement of these goals.

Future research should be devoted to a better understanding of the effects of climate change on the global agri-food sector. In fact, as weather and climate conditions change, firms, communities, and countries need to develop new adaptation strategies to the climate regimes. Understanding the relationships between trade and climate change is one of the efforts towards the promotion of sustainable development.

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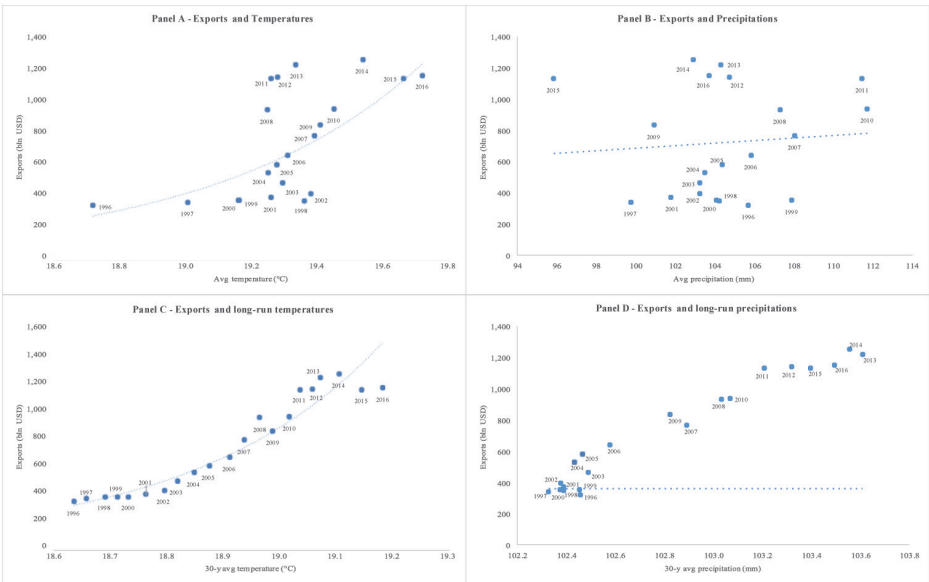
Appendix

Figure A.1 summarises the annual value of exports in food and beverage sectors for the period 1996-2016, plotted against climate. In particular, year-by-year (short-run) changes in average temperatures and precipitations are shown in panels A and B, respectively. Similarly, 30-years (long-run) changes in average temperatures and precipitations are shown in panels C and D, respectively.

Figure A.1 - Scatter plot of trade and climate data



Source: authors' elaboration on data from Climate Change Knowledge Portal and World Integrated Trade Solution database.

Notes: export data aggregated at one-digit level of the classification by Broad Economic Categories (BEC) and consider 'Food and beverages' (BEC, 1996: 01).

Temperatures and precipitations are annual averages in panels A and B and 30-years annual averages in panels C and D.

At the global level, the value of exports and average temperatures (both short- and long-run) are characterised by a growing trend overtime; the rainfall levels are more erratic in the short-run (figure A.1, panel B), but present a steadily growing trend in the long-run (figure A.1, panel D). Trade in the food and beverage sectors and climate are positively correlated. By connecting countries, trade may transfer geographically limited climate effects on a global scale (Jones and Olken, 2010). A warmer climate overtime has increased exponentially the value of exports; the greater the rainfall levels, the higher the export values. Such relationships, less marked in the short-run, become stronger in the long-run.

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ISSN 1126-1668
ISSNe 1972-4802