Protected Designation of Origin food chain arrangements: leveraging market power for small-scale producers in marginal regions

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Abstract

Feta cheese is a Greek product under Protection Designation of Origin (PDO), benefiting its producing regions with its marketing potential. However, farmers are, evidently, often excluded from this value chain. This study aims at understanding the opportunities farmers in Greece have for supply chain arrangements (SCA) that ensure fair market participation. It uses a two-step latent class analysis on data from a farm survey to explore and classify farmer-cheesemaker SCAs based on their perceived characteristics, farmers satisfaction, the availability of alternative options and farmers' sustainability objectives. Results highlight the importance of collective arrangements, economic incentives and price formulation mechanisms in forming farmer-inclusive SCAs.

Keywords

Food supply chains, Regional branding, Cheese market, Small ruminant farms, Food marketing

1 Introduction

As food supply chains become more globalized there is an increasing need to understand the origins of food provision and to reconnect producers and consumers by re-localizing food production.

The EU's Green Deal (European Commision, 2020a) and Farm to Fork strategies (European Commision, 2020b) set out ambitious plans to make European agriculture more sustainable, including support and investment in the social sustainability of farming communities and regions. Under this new policy directive, promoting the uniqueness of EU agricultural produce remains key. In this context, products under Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) (Annex 1) are at the heart of strategies to promote the quality and uniqueness of local agricultural products from European regions. In fact, the Regulation on PDOs and PGIs has existed since the birth of the European Union and a key strategic asset in the quality differentiation of the EU-agro-food market (European Council, 1992).

Given this prominence in European food quality governance, it is easy to see why the PDO/PGI scheme is widely celebrated as an exemplar Geographical Indication, connecting European foods with their

places and regions of origin. This collective governance scheme provides many benefits to consumers, the main one being quality assurance. In addition, a product benefiting from this regulation can achieve premium prices and increase their market share, implying benefits also for primary producers (Sgroi and Modica, 2022). PDOs and PGIs work, then, to bridge 'societal recognition' for sustainability concerns and 'reconnection' through territorial re-localisation. This is particularly important for disadvantaged areas of the EU because it can act as a valorisation mechanism that enhances their economies (Naldi et al., 2015). However, despite these benefits, primary producers may not be experiencing significantly higher profits (FAO, 2019).

Feta cheese is a characteristic example of this latter situation. Feta cheese is recognised as a traditional Greek product, under Protected Designation of Origin (PDO) (European Commission, 2002)[1]. Although regulated by the same principles as local products, the PDO feta cheese is unique in the sense that it is not a product of regional but of national designation of origin. PDO feta production is paramount for the maintenance and development of the livestock sector in Greece. It is produced entirely from small ruminants' (SR) milk, sourced from local farm systems that produce milk to specific quality standards that meet the PDO requirements. The market absorbs around 80% of the total SR milk production in Greece (ELGO-DIMITRA, 2016). It is also the most important food product in Greece, covering 60% of the country's total dairy industry and accounting for 8.8% of total Greek agricultural product output (Eurostat, 2019). Currently, it is one of the main Greek exporting products with a turnover of (approx.) 260 million € per year. (ELSTAT, 2016).

As a PDO product, feta cheese comes with with higher retail prices. Therefore, the production of PDO feta should be beneficial for the profitability and sustainability of SR milk providers. However, in most cases, while cheese-making businesses are able to negotiate their market share, depending on their size and capacity (Anthopoulou and Goussios, 2015), milk producers are entirely "cut-off" from the benefits of the PDO mark-up along the value chain (Kizos and Vakoufaris, 2011). This paper examines the link between traditional production of Feta cheese and market participation, with a view to identifying how GI requirements afford local small-scale producers in less-favourite territories leverage to negotiate market contracts. Given the uniqueness and importance of PDO production sectors, this is critical to highlight the extent to which current supply chain arrangements (SCA) meet farmers needs and requirements and the grounds for satisfactory participation for important PDO agricultural products like feta cheese in the future. Specifically, we analyse existing contractual arrangements between SR milk producers and cheese-makers. We employ a one-step latent class analysis model to identify patterns and create "types" of contractual arrangements; we then examine the extent to which these "types" are

[1] The Protected designation of Origin (PDO)/ Protected Geographical indicator (PGI) scheme was introduced by the European Commission in 2002. It involves a labelling system that differentiates products by highlighting the added value of unique local features, and aims at increasing the participation of small local producers in the food value chain. The PDO/ PGI scheme cover all types of locally produced food but cheese is the most important sector in terms of EU PDO/PGI sales value (40% of agricultural and food PDO/PGI scheme sales value), with 88% of that produced in in Italy, France and Greece.

associated with farmers' satisfaction, farmers' sale opportunities, and opportunities for ensuring the achievements of farmers' sustainability goals. Thus, the paper develops a conceptual proposition for the analysis of supply chain arrangements (vertical and horizontal) as soft market techniques to support the participation of small producers.

2 Traditional food production, PDOs and farmer participation

Despite the significant benefits of PDOs as a medium for recognition and reconnection, we observe a fundamental weakness in the direct benefits accruing to small-scale, in this case, SR milk producers, at least in some arrangements. One reason identified for this, is the low participation of primary producers in marketing channels and the limited possibilities of farmers to add value to their product through their contractual arrangements (European Commission, 2017). In countries like Greece, where primary production is an essential part of the rural economy (ELSTAT, 2016), this can pose major risks, especially to regions with marginal or small and extensive agricultural systems, as dissatisfied farmers may cease farming activities to seek alternative, more remunerative, employment opportunities (Kyrkilis and Simeon, 2015; Micha et al., 2015). This could cause major disruptions in the preservation and development of rural areas, but could also create substantial gaps in the supply of primary products to the food production industry.

For PDO feta specifically, there are suggestions that SR milk producers, particularly the smaller and more vulnerable ones, are often limited in their choices and negotiating power due to external factors such as remoteness and their inability to meet the buyer's needs. The structure of the supply chain creates unbalanced market power and information asymmetries, at the expense of milk producers, particularly the small and more fragmented ones, who suffer from limited negotiating power and unsatisfactory integration within the PDO feta value chain (Tzouramani, 2016). This imbalance persists despite recognition that their milk production is essential for the entire sector. This may render the Greek sheep and goats farming systems unsustainable not only in financial terms, but also in social and environmental sustainability terms, jeopardizing the future of the sector (Tzanopoulos et al., 2011).

Currently, there is an increasing national and global demand for feta PDO, which creates incentives to expand the industry and the provision of locally produced high quality milk (ICAP, 2019). This calls for the need to guarantee that SR milk production systems continue to exist locally, and that producers have incentives to continue providing high quality milk to cheese manufacturers. To ensure this, better integration of Greek farmers within the PDO feta value chain is essential, especially in a fair way that recognises their role and value (Zygoyiannis, 2006). For this case, and traditional food production generally, this raises an important question about market participation and GI requirements that can empower local producer leverage. In this respect, the literature on vertical and horizontal supply chain arrangements (SCA) is useful to examine different configurations that shape farmers participation and integration within the value chain, with a view to identifying arrangements that reduce potential unfair trade practices and boost the vitality of farms, including their ability to strengthen their position in the

value chain, and the achievement of their sustainability goals (Creemers et al., 2019). In the literature, vertical co-ordination usually refers to supply chain relationships, symbolised by the rise of contracting and vertical integration, but becoming increasingly hybrid in organisational design (Grandori, 2015).Horizontal co-ordination signify farmers or buyers coming together in co-operatives, associations or other forms of organisation, which can include GI-type promotion and branding protection arrangements. For feta cheese, PDO creates a market structure in the region, but this is polymorphic and has implications in terms of contracts, producer leverage, on-farm sustainability and use of the label to market the product.

A number of previous studies examine farmers' participation in food supply chains. They focus mostly on production system in Africa and southeast Asia and examine farmers' decisions to participate in food supply chains as opposed to other selling options (Abebe et al., 2013; Aggestam et al., 2017; Behzadi et al., 2018; Fischer and Wollni, 2018; Gelaw et al., 2016; Van den Broeck et al., 2017). Most assume that the farmers' goal is to maximize the financial stability of their farming activity, but are less focused on farms' sustainability objectives. Moreover, studies focus on supply chains where the primary agricultural product is the final market good, without interfacing with the manufacturing sector – this latter component is significant given that farmer-consumer relationships are mediated by this sector, including local production of feta, where farmers sell their milk to cheese processors. Finally, the majority of approaches examine farmers' choice of contract against alternatives by treating the sample as a homogenous group, which fails to account for heterogeneities among farmer responses.

In this paper, we address these issues in a number of ways. Firstly, we examine the degree to which farmers lack alternative options to sell their product and how this affects their decisions. Secondly, we focus on the market of a secondary food product that is the result of processing and manufacturing. In this market, the role and participation of farmers depends on various factors including their contractual arrangements. Thirdly, we incorporate the cognitive element of farms' perceived sustainability, which includes disentangling the economic, social and environmental pillars, and, finally, we generate robust farmer "types" to account for heterogeneity across the sample. These "types" are key parameters to understand farmers' level of satisfaction with their arrangements and produce useful recommendations for improvement of GI recommendations to give local traditional producers increased leverage. The study's results therefore enable a better understanding of the factors influencing farmers' decisions and lead to targeted policy recommendations towards an inclusive supply chain that will ensure the future of the sector. We turn now to explain how the analytical framework, case study and research methodology were designed, organised and implemented.

3 Methodology

Given the arguments above about supply chain arrangements and the need to embed analysis in regional and institutional contexts, this paper provides a detailed analysis of PDO feta in Thessaly. The methodology was organised to address three objectives: firstly, to identify and classify the main

characteristics of the SCAs between SR milk producers and cheese manufactures and their correlation with producers' satisfaction with their current arrangement; secondly, to investigate farmers' ability to negotiate their position in the supply chain and the impact of this ability on their choices; and finally, to explore whether the chosen arrangements are addressing the goals for sustainable development of farms. We explain these components further below after introducing the PDO feta case study.

3.1 Case study: PDO feta in Thessaly

The study focuses on specific areas in the region of Thessaly. Located in the centre of mainland Greece, Thessaly has 861,000 ha of UAA - 15% of the total Greek UAA and 30% of the national feta cheese is produced here. Thessaly has in total approximately 9,500 SR milk producers who produce 140.000 tons of milk per year[2], corresponding to 36% of the national production (ELGO-DIMITRA, 2016) and 85% of that is use for PDO feta. There are 75 cheese producing facilities including two large co-operatives, and three out of the five largest dairy processing facilities in Greece. Thessaly also has numerous small and medium scale enterprises that hold smaller market shares and operate at a more localized level.

The distinction between large and small dairy lies, apart from their capacity, in their flexibility and their relation with the supply chain. Large dairies and co-operatives are adaptable to price fluctuations, they provide higher guarantees to farmers and can reduce suppliers' transaction costs by providing collection and transport services. Small dairies use more traditional methods, often operate seasonally, and they cover a smaller share of the domestic local markets, through direct sales on-site and to local shops. They often struggle to cope with price volatility but they are important for the sustainable development of the area, as they care more about the environment and about high-quality standards, and they are willing to support producers who cannot have access to larger dairies (Anthopoulou and Goussios, 2015).

3.2 Data collection

The study uses data from a survey targeted at sheep and goat milk producers who supply the PDO feta industry. The specific objectives of the survey were to: a) map existing SCAs, by describing different typologies of SCAs and their prevalence; b) identify the attributes characterising SCAs (e.g. price formation, costs of arrangements); c) assess farmers' satisfaction and their perception of bargaining asymmetry with buyers and d) assess farmers' perceived sustainability of their production management choices that are related to their contractual arrangements. The survey was conducted via face to face interviews using an anonymous questionnaire. A total of 248 randomly chosen farmers from the Thessaly region were interviewed[3].

In addition to the survey data, three focus groups were organized to gather qualitative information on the prevalent SCAs in the Thessaly feta sector. Participating to the focus groups were farmers and other stakeholders in the region. For detailed information on the focus groups methodology and results see

[2] The SR milk production is not linearly related to the feta cheese production in the area. This study works under the assumption that farmers mainly sell their product locally.

[3] All farmers filled in one questionnaire each with the help of the enumerators and all responses were weighted equally. The farmers were selected randomly and the questionnaires are anonymous.

Tsakalou and Vlahos (2018). Given the scarcity of literature on feta production and supply chain, the information gathered in the focus groups is used in the results section to discuss and interpret the findings from the LCA model.

3.3 Model estimation

3.3.1 Conceptual framework

Using the survey data, we identify patterns in sale agreements between farmers and buyers, by dividing farmers into distinct groups that depict the differences in their sale arrangements choices and derived satisfaction. We use a latent class modelling approach to identify classes within farmers' sales arrangements and to estimate the probability of a farmers belonging to a particular class (Hair et al., 2010). Latent class analysis (LCA) is a clustering method, commonly used to quantify and classify the existing heterogeneity among members of a population (Zhang et al., 2016). It was chosen in this study because of its strong explanatory power, based on data distribution, its ability to determine probabilities in the data, and its potential to explain underlying factors correlating with the sample distribution (Hagenaars and McCutcheon, 2002). For the generation of the latent classes, a set of 'classification variables' is necessary. Classification variables are selected based on the heterogeneity under investigation (Dean and Raftery, 2009), therefore we choose those variables that explain the contract specifications and the perceived producers' satisfaction. The classification variables chosen for the analysis are summarized in Table 1.

Table 1: Classification variables used for the latent class analysis

Variable	Description	Frequency (% sample)	
		0	1
Type	Describes whether the buyer is an individual private business or a collective organization such as a cooperative (0=individual, 1 = collective)	84.4	15.6
Agreement	Indicates whether the agreement between the farmer and the buyer is formal (e.g. a written contract enforceable in a court of law) or informal (e.g. a verbal agreement not enforceable in a court of law) (0=formal, 1 = informal)	40.29	59.71
Fixed Price	Describes whether a fixed milk price is negotiated, or if the milk price is variable depending on factors inspected at delivery (0=fixed, 1-variable)	35.46	64.54

Stable price	The sale agreement provides year-to-year stable prices – this variable is a proxy indicator of protection from price volatility (0=unstable,1=stable)	73.76	26.24
Assets	The agreement includes the provision of assets to the farmers such as machinery, consumables, and technological equipment*.	69.50	30.50
Exclusivity	Indicates if the agreement requires exclusivity (have to sell 100% of product to this buyer)	46.10	53.90
Services	Indicates if the agreement includes the provision of i.e advisory services*.	21.99	78.01
Automatic extension	Indicates whether the agreement includes is an automatic extension mechanism*	75.89	24.11
Duration	Describes the duration of the sale agreement (0=less than 4 years, 1= 4 or more years)	75.18	24.82
Negotiation power	The sale agreement provides possibilities for negotiating prices – this variable is a proxy for the fairness of the agreement, assuming that farmers with no say suffer from power disadvantage*	85.81	14.19
Satisfaction	Describes whether the producer is satisfied with the terms and the results of their agreement (0=not satisfied, 1= satisfied)	57.45	42.55
0-No, 1 =yes			

We assume that the probability of a farmer belonging to a particular class correlates to a number of external factors. We identify the external factors based on the literature on the drivers of SCAs formation and adoption which distinguishes between internal and external factors characterizing different types of supply chains (e.g Tzanopoulos et al., 2011; Vassalos et al., 2016). Based on this literature, we identify three external factors that are likely to influence different classes of SCAs in the context of our case study: a) having alternative choices for contractual arrangements which can generate competitive behaviour between buyers leading to the offering of different types of arrangements and reducing problems of "lock-in situations" into unfair agreements (Gereffi et al., 2005); b) farm size under the assumption that larger farms producing larger volumes of milk might have a greater capacity in negotiating more favourable agreements (Sexton, 2012); c) farmers' sustainability goals and objectives, under the hypothesis that they are linked to the survival and welfare of farm businesses and households, and as such they are drivers of farmers choices (Creemers et al., 2019).

To examine how probability of class membership is correlated to these components, we incorporate them in the latent class analysis as **independent covariates**, under the assumption that their error terms are correlated with the independent variables of the latent class model. Our LCA model is estimated

including the condition that the latent variables depend on the covariates. The variables introduced as covariates are presented in Table 2.

Table 2: Variables used as covariates in the latent class analysis

Variable	Type	Description
Alternative	Binary	Describes the perceived existence of potential alternative sale arrangements for a farmer (0=no alternative, 1=otherwise)
Farm size	Numeric	Herd size expressed as the number of animals
Social sustainability	Numeric	Composite indicator, resulting from principal component analysis of selected variables (annex 1), expressing farmers social sustainability goals
Economic sustainability	Numeric	Composite indicator resulting from principal component analysis of selected variables (annex 1), expressing farmers economic sustainability goals
Environmental sustainability	Numeric	Composite indicators expressing farmers' environmental sustainability goals (resulting from principal component analysis of selected variables (annex 1, note that this indicator is associated with reduced profitability)

The conceptual framework of the latent class model is presented in Figure 1:

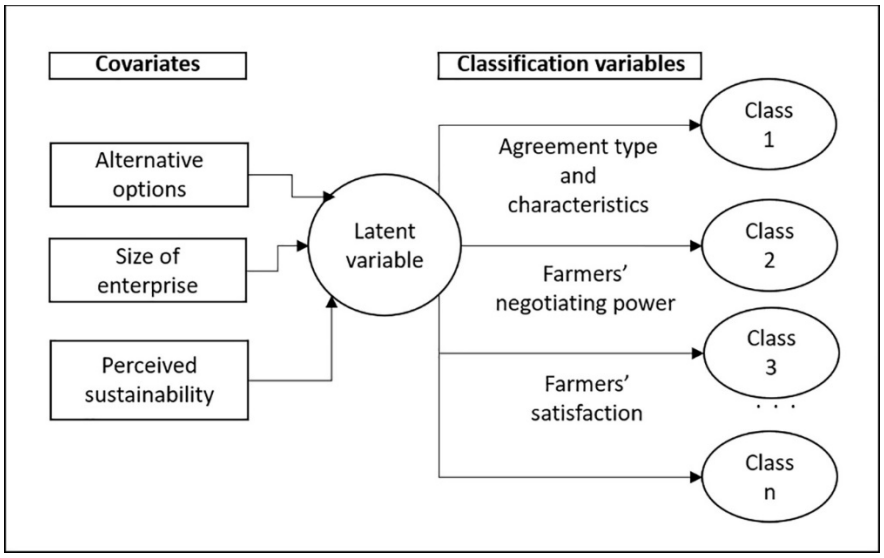

Figure 1: Conceptual framework of the latent class analysis model

3.3.2 Empirical estimation

The LC modelling starts from a basic equation expressing the probability of observing response pattern *y* defined by:

$p(Y = y) = \sum c = 1Cp(X = c) \times p(Y = y|X = c)$ *(1)*

where X is a categorical latent variable,c is a specific latent class among C classes, and y is the realization of the vector Y measuring the response patterns $X \rightarrow Y$.

$p(X = c)$ represents the probability that a farm belongs to class c and $p(Y = y|X = c)$ the conditional probability of having response pattern y, given that X belongs to the specific class c.

When covariates are included in the model, then the model estimates the joint probabilities of three sets of variables (X, Y, and Ψ) (Bakk et al., 2013).

$P(\Psi = \psi, X = x, Y = y) = p(\Psi = \psi, X = c)p(\Psi = \psi, X = c)$ *(2)*

where Ψ is the covariate vector.

Assuming the principle of local independence for Y and Ψ, given X, and including the condition that the latent variable depends on the covariate Ψ, the relation can be finally stated from which the relationship between X and Ψ can be analysed as seen in equation 3 (Stamovlasis et al., 2018):

$P(X = c, Y = y|\Psi = \psi) = p(X = c|\Psi = \psi)p(Y = y|X = c)$ *(3)*

We use a latent class conditional logit model, which simultaneously estimates preference coefficients for different classes and the probability of an individual to belong to a class based on individual covariates. The latent class model was fitted using generalized structural equation model (GSEM) in STATA 15, using the maximum likelihood estimation method, under the assumption that that the observed variables are uncorrelated and equally distributed across the sample.

To decide on the optimal number of classes to be retained, we used statistical information criteria that indicate the best model fit. We examine 4 criteria, namely the *log-likelihood* (LL), the *Akaike Information Crit*eria (AIC), the *Bayesian Information Criteria* (BIC), with smaller values indicating better fit (Nylund et al., 2007) and the *entropy* values, with the highest value indicating better fit (Ulbricht et al., 2018).

4 Results and discussion

The LCA produced three classes of farmers (the goodness of fit tests are presented in Annex 1). The results of the LCA model are presented in Table 3. The first latent class was estimated to have a class membership probability of 18.36% meaning that this percentage of the sample is likely to be a member of this class. The estimated class membership probability for Class 2 was 47.54% and for class 3 it was 34.09%.

Table 3: Percentage response probabilities by class (classification variables)

	Class		

	1	2	3
Indicator variables			
Type			
Collective	63.10%	0.00%	11.78%
Individual	36.90%	100.00%	88.22%
Agreement			
Formal	86.84%	40.33%	15.31%
Informal	13.16%	59.67%	84.69%
Price			
Fixed	62.73%	37.03%	18.59%
Variable	37.27%	62.97%	81.41%
Duration			
Less than 4 years	73.81%	69.40%	83.97%
More than 4 years	26.19%	30.60%	16.03%
Stable prices			
No	29.64%	52.86%	41.38%
Yes	70.36%	47.14%	58.62%
Assets			
No	70.08% [a]	83.73%	49.35% [a]
Yes	29.92% [a]	16.27%	50.65% [a]
Exclusivity			
No	5.80%	55.13%	55.21%
Yes	94.20%	44.87% [a]	44.79%
Services			
No	4.32%	28.31%	22.68%
Yes	95.68%	71.69%	77.32%
Automatic extension			
No	52.15%	91.73%	66.58%
Yes	47.85%	8.27%	33.42%
Negotiating power			
No	53.85%	97.06%	87.23%
Yes	46.15%	2.94%	12.77%
Satisfaction			
Not satisfied	38.25%	100.00%	8.42%

Satisfied	61.75%	0.00%	91.58%

The marginal effects of the covariates on cluster membership probability are presented in Table 4.

Table 4 Marginal effects of covariates on the latent class responses (st. errors in brackets)

Variable	Marginal effect		
	Class 1	Class2	Class 3
Alternative	0.086 (0.421)	-0.237 (0.080) ***	0.150 (0.090) **
Size of enterprise	0.001 (0.000)	0.000 (0.000)	0.007 (0.000) **
Social sustainability	0.179 (0.029) ***	-0.148 (0.068) ***	-0.030 (0.051)
Economic sustainability	0.067 (0.030) ***	-0.154 (0.040) ***	0.086 (0.038) **
Environmental sustainability	-0.098 (0.030) ***	0.140 (0.038) ***	-0.042 (0.041) *

Statistically significant at: ***1%, **5%, *10%

Based on the classes' characteristics emerging in Tables 3 and 4, it is possible to interpret and label the classes as *collective socially sustainable SCAs, individual unsatisfactory environmentally sustainable SCAs* and *individual satisfactory economically sustainable SCAs*. Below is a detailed description of these clusters and the factors affecting their membership probabilities.

- ***Class 1: Collective, socially sustainable SCAs***

This class has the lower membership probability and represents farmers who have formal agreement types (Table 3). This class is characterized by a certain degree of stability and fairness, as most farmers are likely to receive stable prices and services, and have the highest degree of automatic extension and negotiating power. However, in almost all cases the arrangement requires exclusivity[4], hence limiting the farmers' opportunities of market diversification, and the majority does not receive assets from their buyer. Overall, the level of farmers satisfaction for this class is quite good (61, 75%). This class of arrangements seems to provide farmers with market access and price stability, leading to higher horizontal integration thanks also to the negotiating opportunities and the services provided by the agreement. However, such stability is counterbalanced by a close exclusive relationship creating possible dependence and vulnerability.

The membership probability of this cluster is increased with their perceived social and economic sustainability of management practices related to their arrangement (Table 3). Farmers perceiving their

[4] Farmers that join the co-operative have to accept selling their entire production to the co-operative and the co-operative has to buy their entire production. Exclusivity offers reassurance to farmers, but limits their diversification as explained both by co-operative members and non-members in the focus groups.

management practices as environmentally sustainable (although with reduced profitability), are less likely to participate in this class.

As the cluster relates to co-operatives, the relation of co-operatives and satisfaction was looked at during the focus groups' discussions, where farmers highlighted that, although not always obvious to non-members, being a co-operative member can be rewarding as it provides certain unique benefits. First, the fixed contracts and price can work to the farmers advantage as, despite it may not be as high as it could with flexible arrangements, it reduces the market risks (FGs, (Grashuis and Magnier, 2018). Also, co-operative members have the ability to negotiate prices[5], and they can avail of certain benefits such as co-ordination of product delivery, reduced transaction costs (including collection, transport and delivery costs) and access to information and technology, that particularly small scale producers would be unable to achieve by themselves (Ochieng et al., 2017).

However, it was also pointed out that there is a level of mistrust and perceived ineffectiveness regarding the function of co-operatives, which increases farmers' reluctance to join co-operatives. Furthermore, farmers admitted that, despite recognizing the benefits of collective action, they often tend to act under more individualistic motives, reducing their membership commitment (Apparao et al., 2019). However, this is an obstacle that could be overcome through effective advisory support (Volanis et al., 2007). Indeed, focus group participants confirmed that farmers - particularly younger ones- would be more willing to engage in collective arrangements, if they provided more and longer-term support from expert advisors.

Perceived economic sustainability is positively correlated with participation in this class. Tsourgiannis et al. (2008) suggested that Greek SR milk producers selling to co-operatives are profit oriented and avail of the financial security and profitability given by the collective organization. This was confirmed by the focus groups participants who stated that the main benefits of selling to co-operatives was the economic security for their businesses. Economic sustainability is a principal condition for participation in collective organizations (Mikkola, 2008), but it is also perceived as an outcome, as collective arrangements offer smallholders the chance to participate in large scale production at secure prices and with smaller transaction costs (Markelova et al., 2009).

Perceived social sustainability has a stronger positive correlation with class participation than economic sustainability. Assuming that this class represents the co-operative approach and given that co-operatives are by definition multi-stakeholder oriented (Mikkola, 2008), members are able to create social networks through the collective governance and the financial interactions (Hingley et al., 2011). Furthermore, this type of arrangement offers formal written contracts as well as a high level of services which reduces the perceived risk and increases the level of trust (Abebe et al., 2013), influencing the improvement of farmers wellbeing in the long period.

[5] Farmers that are members of co-operatives have the ability to negotiate their delivery prices with the co-operatives

On the other hand, environmental sustainability goals are negatively correlated with farmers' participation in this class. Environmental sustainability is perceived as challenging for cooperatives, as their multi-stakeholder nature makes it difficult to make the necessary investments (Ertler, 2001), due to potential conflicts in the decision making process (Stock et al., 2014). Additionally, as this type of arrangements offers exclusivity[6] to a great extent, it is difficult to guarantee that the entire milk supply is produced in an environmentally friendly manner. Environmental sustainability, on the other hand, has a negative impact on cluster membership. For co-operatives this result is expected because, as explained, environmental goals are perceived as hard to achieve due to the complicated decision-making processes (Stock et al., 2014). Aside from that, there is always a general belief that large-scale processors are less environmentally friendly (Aggestam et al., 2017) and in the case of feta production this applies primarily to large dairies mainly because of the large amount of milk they process, the source of which is harder to trace (Anthopoulou and Goussios, 2018).

- ***Class 2: unsatisfactory, environmentally sustainable SCAs***

The class has the highest membership probability. The results indicate that this class entirely consists of farmers having sale arrangements with individual businesses. Notably, there is around 60% probability that the cluster members have informal arrangements characterised by a relatively high probability of receiving variable prices depending on the milk quality at the moment of delivery.

As seen in Table 4 having an alternative option relates to reduced probability of cluster membership as do social and economic sustainability, while environmental sustainability has a positive impact on cluster membership.

One of the main reasons for farmers dissatisfaction is the perceived low prices of milk, that leads to increased financial insecurity (Tzouramani et al., 2012). As FG participants explained, milk prices are perceived by farmers as lower than they should be, but they believe they have little negotiating power as dairy companies can purchase milk from cheaper providers. The stakeholders in the focus groups pointed towards larger dairies as the main responsible for this issue, although farmers believed all dairies are responsible for the low milk prices and not only the larger ones[7].

On the other hand, dissatisfied farmers mentioned that often they feel that they have no option but to sell to the nearest dairy. This is either because of lack of access to alternative buyers (remoteness, delivery arrangements and costs) or due to strong cultural and social norms within their communities that drive their contractual arrangement choice, like family bonds, friendship and acquaintances. The high impact of social norms on farmer behaviour in Greece and on their contractual arrangements is also reflected in research (Koutsou et al., 2014; Micha et al., 2015). These social norms, according to

[6] For co-operatives in Greece exclusivity mean that the farmers are obliged to sell their entire production to the co-operative, but the co-operative is obliged to buy it.

[7] There is not explicit way to know what type of businesses farmers in this class sell their milk to. The only certainty is that they are not co-operatives. This specification was not included in the survey as it would jeopardise respondents' anonymity.

the focus groups, create an "obligation" to sell to personal aquaintances. This lack of options leaves them with little negotiating power (Table 3) and obliges them to sell their product based on oral agreements founded on personal relationships that often jeopardises their profitability and increases their perceived risk and uncertainty (Barrett et al., 2012). As farmers confirmed, their negotiation power is also limited due to the strong personal relationships that are prioritised over business maximization. Dissatisfaction from lack of options is reinforced by the informality of the agreements, which may be decreasing farmers perceived security and stability, and leave them feeling exposed to unfair treatments, as potential buyers infringing the agreement cannot be taken accountable through the rule of law (Dervillé and Allaire, 2014).

Seasonality and mistrust were also reported as reasons for farmers dissatisfaction and concerned particularly smaller dairies. Farmers reported that many local dairies operate seasonally and are not flexible to price fluctuations, and, as such, their arrangements do not guarantee consistency or financial security, and sometimes they deliver less than they promised. In addition, the small seasonal dairies are usually unable to provide farmers with assets or services, reducing the farmers net profit and adding to the reasons for dissatisfaction. Finally, this class represents arrangements with small probability of automatic renewal (Table 3), which may create high perceived uncertainty for the future, particularly for farmers that have limited alternative opportunities. All the above justify that having alternative options, as well as perceived economic and social sustainability, reduce the probability of cluster 2 membership (Table 4).

Perceived environmental sustainability is positively correlated with this class's membership. As mentioned before, smaller and local artisanal dairies are perceived as more traditional and more environmentally friendly. This is a general perception towards small scale businesses who are often seen as having higher quality and environmental standards as they are thought to address a market with higher demand and price premiums (Aggestam et al., 2017). For these reasons, small artisanal dairies are often seen as "guardians" of the SR milk production system (Anthopoulou and Goussios, 2018), and consequently of the environment and rural areas, as they give market opportunities to small farms who, in reality, have no alternatives. They can, therefore, be more appealing to non-profit oriented farmers that aim to greater environmental sustainability.

- ***Class 3: satisfactory, economically sustainable SCAs***

Nearly one third of the sample is likely to be in this class and the large majority of farmers in this class are likely to have an informal arrangement with individual businesses that buy milk at variable prices decided at the moment of delivery. This class is also characterized by a high level of satisfaction, above 90%, despite most of these arrangements are informal and therefore cannot be enforced in a court of low.

The higher level of satisfaction can be explained by the fact that 58.62% of members perceive the prices they receive as stable. This suggests that, although prices are not agreed with the buyer in advance to

the time of milk delivery, prices are quite stable from season to season. Therefore, there are less uncertainties with respect profits and the continuation of the farming activity over time.

An additional element that is likely to explain the farmers' satisfaction towards this class of SCAs, is the (relatively) high probability of receiving assets from the buyer. This probability is at 50.65% which is the higher across the three classes. Receiving assets or other means of production is a significant benefit for small farmers, because: i) allow production methods that otherwise the farm could not afford; ii) reduce the level of fixed costs due to the acquisition and maintenance of assets; iii) reduce the probability of "holdup problem", that is farmers committing to invest in assets specific to a particular buyer are vulnerable to contract renegotiation on less favourable terms (Crespi et al., 2012).

The low asset specificity allows freedom to change buyer in case there are changes in the terms of the (informal) agreement. This might make farmers more comfortable with the idea of automatically extending the agreement from one year to the other. Indeed, 33.42% of farmers in this class have an automatic extension of contracts. However, as seen in Table 4, having alternatives increases the probability of cluster membership by 16.8%. This suggests that the satisfaction is linked to having the possibility of easily change buyer, not only thanks to the characteristics of the agreement itself, but also through the availability of alternative market channels. However, it should be noted that with higher benefits and stability farmers have less incentives to change arrangement or buyer, therefore the choice of the arrangement depends also on the farmer's entrepreneurship and propensity towards risks.

Interestingly, class 3 is the only one with a positive and statistically significant marginal effect of the size of the herd, although the magnitude of the effect is small (Table 4). Moreover, interest in economic sustainability has a positive impact on cluster membership, with social and environmental sustainability having no significant impact. This, again can be explained by the consistency and stability of the contractual arrangement and the facilitations in production, delivery and transaction costs. Also, as mentioned earlier, contractual arrangements that allow access to larger share of the markets are related to economic incentives and profit orientation (Tsourgiannis et al., 2008).

- ***Differences between classes 2 and 3***

At first sight, classes 2 and 3 might seem similar, but the few differences in terms of number factors explaining farmers' participation into one of the two classes are utterly important and suggest a strong distinction. Unlike class 2, in class 3 the informal agreements seem to be related to farmers' satisfaction. There is evidence in literature that suggests that, in some cases, oral contracts can have satisfactory outcomes (Schipmann and Qaim, 2011) if they promote trust and increase the incentives to fulfil the agreement (Abebe et al., 2013). In environments where social relationships can form the basis of trusted business, oral arrangements can actually be more satisfactory than written arrangement. As mentioned by local producers, informal arrangements can be grounded on social norms and relations that are under certain circumstances more trustworthy but also more obliging than formal contracts (Schipmann and Qaim, 2011). This can lead to satisfactory outcomes because it combines the business arrangement with a wider level of social trust. Farmers in this class are satisfied by their arrangement despite their low

negotiation power and the lack of automatic extensions. Farmers satisfaction probably derives from the level and quality of the services received, especially if they include delivery and advisory services (Tsourgiannis et al., 2008) that larger dairies have greater capacity to provide to farmers (Anthopoulou and Goussios, 2018). In addition, satisfaction likelihood may be high in this class in relation to the high percentage of farmers receiving assets that facilitate the production and transport processes and reduce production costs.

The results of the focus groups depicted the differences between satisfactory and non-satisfactory "oral arrangements" as to the framework of the arrangement. Oral arrangements that are made on a business-to-business basis, are based on the social norms of good faith and "word honouring" and can increase the level of trust between parties; oral arrangements that results from personal acquaintances are binding to farmers who's negotiating power is shadowed by strong "friendship" and other emotional social rules. In the second instance, where the buyer can use these arguments to their benefit only, farmers suggested that they would feel safer under some form of written contract.

5 Conclusion and policy implications

In 2019, an ambitious policy framework was proposed by the European Commission, the European Green Deal. The Green Deal strategy expresses, among other things, the EU's priority to develop the competitiveness and internationalization of rural areas (EC, 2019). Both regulatory and non-regulatory initiatives are planned to improve transparency and balanced power in the agri-food supply chain, such as monitoring of the implementation of the Unfair Trading Practices Directive by Member States; strengthen cooperatives and producer organisations in the food supply chain; strengthen the legislative framework on geographical indications (GIs), eventually including specific sustainability criteria.

Geographical indicators, and particularly food products under Protected Designation of origin, can become powerful tools for regional development, contributing to the sustainable development of European agriculture. Along this process, however, it has to be ensured that farmers benefit from the PDO branding, picking up part of the value generated along the supply chain is recognized. In this paper, we analyse what typologies of SCAs are prevalent between SR milk producers and the PDO feta cheese dairy companies in the Thessaly region of Greece, focusing on perceived farmers' sustainability and satisfaction as drivers of choice among the available arrangements. To date, there has been no official impact assessment accompanying the decision-making processes of the Farm2Fork strategy, therefore our results can provide useful supporting evidence for future policy design.

Firstly, the results indicate that the majority of farmers are unsatisfied with their SCA, and this is related to the low price they receive, their marginal participation in the feta cheese value

chain and their weak negotiating power within the supply chain. The lack of alternative buyers further reduces the satisfaction of farmers, a sign of lock-in situations in which farmers have to accept rather than participate into trade deals. Such low satisfaction could effectively jeopardize the future of the sector. Farmers with small size herds in mountainous or remote areas can eventually turn to other non-farming job opportunities. This could lead to the concentration of SR milk to semi-mountainous and plain areas, and fewer more competitive and profitable farms, and eventually lead to the abandonment of mountainous areas all together, with detrimental effects on the socio, economic and ecological system. The issues of abandonment of SR farming in mountainous areas, are addresses by the EU through financial support for farming in areas with natural constrains. However, these subsidies, in combination with non- satisfactory market participation, could lead farmers to increasingly rely on these for their survival. Such a "detachment" of farmers from the market could create a major disturbance in the production of feta cheese; high quality mountain- produced milk would not reach cheese factories. In this case, one of the main attributes of feta cheese - namely being the product of free-range small ruminants - would be lost.

Second, the farmers' choice of SCA is strongly influenced by social and cultural norms, which makes them behave "irrationally" from an economic point of view, by accepting unfavourable agreements. Smaller and local dairies cannot afford offering SR farmers services or assets with the SCA, creating a disadvantage against larger dairy companies that can absorb part of farmers' transaction costs. To overcome such disadvantage, small dairy companies use personal and informal relations to access both farmers and markets, often leading to unsatisfying agreements. This may be threatening the viability of small and local dairy companies in the long term, eventually leading to a concentration of the sector towards few enterprises dominating the market. Therefore, further reducing farmers participation in the value chain is jeopardizing the role of small dairies as local job providers and defenders of the artisanal and traditional business models and lifestyle.

Third, the perceived environmental sustainability is negatively correlated with perceived profitability and it reduces participation in the "satisfied clusters". In other words, farmers that prioritize environmental sustainability are less likely to have a satisfactory and profitable contractual arrangement. This suggests that sustainability objectives are fragmented across the farming and manufacturing processes, and it is difficult for primary producers to satisfy both the needs for economic and environmental sustainability through a comprehensive SCA. According to the Farm2Fork strategy, a sustainable but competitive food supply chain should cover all fundamental aspects of sustainability (European Commission, 2020), therefore

environmental sustainability should be integrated with successful economic outcomes and that environmental concerns should be addressed in a more efficient way. In the light of the current and future environmental challenges, the feta cheese market has to address environmental sustainability to be able to support its competitiveness.

Overall, it is evident that the interconnection between participation in the supply chain and farm sustainability cannot be overlooked. This calls for policies that go beyond agriculture and integrate a broader resilience-oriented perspective (Buitenhuis et al., 2020). Based on the discussion of the paper's results, and in line with the EU *Farm2Fork* initiatives and guidelines, a number of policy responses can be suggested, as concluding remarks:

- Encourage regionally-based direct connection of producers to the marketing channels. This would reduce problems related to the lack of alternative buyers, avoiding locked-in situations. As suggested by Ashkenazy et al. (2018) supporting locally based supply chains can increase transparency in transactions and provide better understanding of the local rural realities. In theory, practical support of locally based supply chains should be part of an adaptive rural policy beyond the boundaries of agriculture, which could help re-enforce the position of small milk farmers in the value chain and also create more marketing channels that could eventually increase both their income and their negotiation powers.
- Improve the market infrastructure to address remoteness and the consequent high transport and transaction costs, integrating rural development policies supporting the sustainable intensification of farms and the quality of lifestyle in rural areas. Innovation can play a pivotal role in improving market access also in remote areas, through online market platform in which supply and demand can meet also at long distances. This would benefit in particular SR milk producers in mountainous and semi-mountainous areas which do not receive collection and transport services from the SCA.
- Provide incentives towards formal and legally enforceable contractual arrangements, including incentives for the use of newest technologies in transactions. An online, adaptable and formal process to design agreements could discourage participation in informal arrangements and provide clearer terms benefiting all actors. Such process could increase the number of alternative buyers and therefore improve the farmers negotiating position.
- Facilitate collective initiatives, both between farmers and between small, local dairies through financial support, such as access to credit and tax relief, combined with advisory support. Co-operation can help reduce the fragmentation of sustainability goals, by reducing individual costs and improving profitability and economic sustainability, creating social

networks in which successful experiences can be shared and supported and adopting environmental standards and practices difficult to implement at the individual level. Cooperation focusing on social equality and provision of ecosystems services can also use these functions as part their marketing strategies. These interventions however, should be based on socio-economic and cognitive factors that drive farmers decisions to join co-operatives and on innovative solution extracted from non-linear co-management and system thinking approaches as the current literature suggests.

- Design an effective monitoring and traceability mechanisms for SCAs to enforce fairness in the supply chain. An efficient, policy driven monitoring system would improve the transparency of the food chain and assist in avoiding contractual arrangements with disappointing outcomes for the farmers. These initiatives could improve the level of satisfaction of farmers in class 2. Support for co-operation initiatives should be combined with effective monitoring mechanisms, using online tools and independent procedures, improving trust in collaborations.
- Enforce policies that consider the cultural norms that drive the choice of arrangements and participation in the value chain. This could result in the failure in farmers' up-taking of new SCA and can be perceived as barriers by policymakers wanting to apply a "one size fits all" policy. However, the declination of European policies at local level cannot disregard the heterogeneity of cultural and historical drivers of business, therefore sufficient flexibility and adaptability of policies is a pre-requisite for their success.

It is a responsibility of effective policy design to ensure that the structure of food supply chains safeguards the sustainability of farming systems and defends farmers' needs. The exploration of the success of the SCAs in supply chain of the feta cheese can indicate a path for a balanced use of the branding mechanisms that can improve the relationship between SR milk producers and manufacturers and food value chains, that can add value to the EU, national and local economy. There is potential for these SCAs to be improved with the adoption of innovation and strategic PDO policies that can help producer claim a greater share of the market and have their role more greatly recognized in the food supply chain, taking into consideration the vitality of their farm systems and their sustainability goals and objectives. This will primarily be beneficial for small extensive SR farmers and consequently for the sustainability and development of rural, mountainous and remote socio-ecological systems and regions.

It is established that ensuring the branding of local products is not enough for the sustainability of the farming systems that support the feta PDO production. A higher level of inclusion of primary producers in the value chain, via viable and sustainable contractual arrangements that guarantee their fair

participation is crucial, and the pathway for this achievement goes through context specific incentives that support the holistic sustainable development of European countryside. There is potential for SCAs to be improved with the adoption of innovation and strategic policy design that can help producer claim a greater share of the market and have their role more greatly recognized in the food supply chain, taking into consideration the vitality of their farm systems and their sustainability goals and objectives. This will be beneficial not only for the PDO feta industry, but also for local communities and for the maintenance and development of remote and rural areas.

In terms of research this paper adds to the existing literature by shedding light into how local socio-economic context can alter the position of farmers in the value chain of high valued PDO products. It is an attempt to create types of arrangement within the context of a regional brand rather than throughout the European framework. Further research suggestions include the evaluation of the changes such a typology could bring if considered in the regional policy design and the investigation of the impact of a farmer belong to a typology to their sustainability objectives and their overall farm management decision making.

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Annex 1

6.1.1 A1. EU geographical indicators

The EU regulation on agricultural products with protected geographical indicators exists since 2012 (European Parliament and European Council, 2012) ('GI Regulation') and includes the following Geographical indicators This provides for the following two GIs:

- Protected Designation of Origin (PDO): This is assigned to products 'whose quality or characteristics are essentially or exclusively due to a particular geographical environment' and their 'inherent natural and human factors' (GI Regulation, Article 5(1)(b)), meaning that they need both local ingredients and local unique expertise for their manufacturing.

- Protected Geographical Indication (PGI): Products whose 'quality, reputation or other characteristic is essentially attributable to its geographical origin' (GI Regulation, Article 5(2)(b)). This means that products need to be developed in a specific geographical area but the rules of production are up to the manufacturers (GI Regulation, Article 5(2)(c)).

6.1.2 A2. Perceived sustainability composite indicators

Perceived sustainability was assessed using multiple statements designed to describe the perceived sustainable outcomes of farmers' production practices. Farmers expressed their agreement to the statements based on a five-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). Twelve statements were used in total (presented in Table A1), that related to the three pillars of sustainability: economic, social and environmental. In order to obtain single measures of perceived sustainability, the Principal Component Analysis (PCA) was used as a data reduction technique. This method allowed for the identification of patterns in perceived sustainability of production management choices, by producing composite sustainability indicators that each correlate to a number of statements but are uncorrelated to each other. The Kaiser-Meyer-Olkin measure of sampling adequacy was used to establish data suitability and the produced principal components with an Eigen-value > 1 were kept for further analysis (Field, 2017). The PCA rendered 3 Principal Components that express the composite indicators of perceived economic, social and environmental sustainability of sale-related farm management practices, which were used as explanatory variables in the latent class analysis.

The statements used in the PCA, their average scores across the sample and their correlation with the composite indicators produced are presented in Table A1. The first component is positively related to 4 statements expressing social sustainability, the second component is positively related to 3 statements expressing economic sustainability and animal welfare, while the third components is positively related to 3 statements expressing environmental sustainability and negatively related to maintaining profitability. The components generated by this process were used as variables in the analysis of this study.

Table A3: Perceived sustaibaibility statements, average scores and correlation to composite indicators[8]

Statement (perceived sustainable **outcome** of production management related to contractual arrangement).	Sustainability Pillar	Average score	Contribution of each statement in the composite sustainability indicators		
My contractual arrangement should help me:			Indicator 1: Social sustainability	Indicator 2: Economic sustainability	Indicator 3: Environmental sustainability

[8] Papers on from which these were

Achieve societal recognition of farm activities	Social	1.85	0.853		
Connect with other farmers	Social	1.88	0.811		
Secure successor	Social	1.67	0.783		
Create good connection with buyers and input providers	Social	1.93	0.727		
Sell the product in periods when there were low prices	Economic	2.08		0.736	
Invest in the farm business	Economic	2.98		0.714	
Cope with changing market conditions	Economic	2.00		0.704	
Support animal welfare	Environmental	2.47		0.654	
Maintain profitability	Economic	3.89			-0.796
Maintain water quality	Environmental	1.54			0.581
Maintain biodiversity	Environmental	1.83			0.517
Maintain organic matter	Environmental	1.92			0.657
	Kaiser-Meyer-Olkin Measure of Sampling Adequacy. == 0.829				

6.1.3 A3. Goodness of fit tests

The GOF tests compared the model fit for 2, 3 and 4 latent classes. The results of the GOF tests are presented in Table 4. According to the GOF tests, the optimum number of classes to be retained in the analysis is 3.

Table A2: Fit statistics for model estimation with 2, 3, and 4 latent classes.

Number of Classes	LL	AIC	BIC	Entropy
2 classes	-392.34	816.675	864.855	0.460
3 classes	-367.92	**787.846**	**863.513**	**0.674**
4 classes	**-357.77**	791.559	903.612	0.552