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The profitability of value-added products in dairy farm diversification initiatives

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Abstract

A more open and competitive dairy market has encouraged certain dairy farms to adopt value-adding strategies in order to achieve a higher profitability, which may be important for farms' survival. This paper investigated the role of some product characteristics in the profitability of value-added products in these farms. For this purpose, we used a unique database of 265 different products commercialized by 49 Spanish dairy farms that offers information on nine attributes of each product. Using hedonic models as a baseline, we examined the influence of these attributes on the margin per liter (ML) of the products. The results of the regression indicated that cheese and yogurt generated 0.688 and 1.518 € more of margin per liter than liquid milk. Similarly, we found a set of attributes that have a positive influence on ML, including possession of a certificate of protected designation of origin (PDO), the milk-type composition (proportion of sheep milk), a longer expiration period, and involvement in direct marketing strategies (DMS). However, other recognized attributes such as organic labeling, maturation period, size of the sales unit and returnable packaging did not have a significant influence on ML. Our findings also showed that firms producing more elaborated products as cheese and yogurt need a lower percentage of their production to cover the fixed costs associated to transformation and commercialization. Overall, our results revealed that the elaboration of value-added dairy products improves the profitability of dairy farms.

Additional key words: Northern Spain; dairy products; agri-food attributes; niche markets; direct marketing strategies; processing strategies; hedonic models.

Abbreviations used: CAP (Common Agricultural Policy); DMS (Direct Marketing Strategies); EU (European Union); IL (income per liter); ML (margin per liter); PDO (protected designation of origin); VCL (variable cost per liter).

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Introduction

Diversification via processing and direct marketing of agricultural products is one of the strategies available to farmers in order to maintain a competitive position in the market. This type of diversification, promoted by the European Union (EU) and supported by the new Common Agricultural Policy (CAP) 2014-2020, tends to focus on differentiated products, sometimes certified with protected designation of origin (PDO), and aimed at niche markets.

Specifically, regarding the EU dairy sector, since 2003 a series of reforms to the CAP have led to market forces now being the main determinant of milk prices. As a result of this process, milk prices have fallen due to cuts in intervention prices, becoming more in line with world prices. Due to the fall in the price of raw milk, certain dairy farms have adopted a strategy of entering the business of processing the raw milk in order to achieve higher margins.

Although many studies have focused on the profitability and efficiency of milk production in dairy farms (*e.g.* Tauer, 2001; Cabrera *et al.*, 2010; Casasnovas-Oliva & Aldanondo-Ochoa, 2014), a gap exists with respect to the study of the profitability of processing activities (Becker *et al.*, 2007; Bouma *et al.*, 2014). This is a relatively under-investigated field of research due to the difficulty of obtaining data and the problem of separating the value of transformation activities from the milk production results.

The objective of this paper was to investigate the factors that explain the profitability of value-added products in dairy farms. For this purpose we used a unique database from a group of Spanish farms involved in diversification via the elaboration and sale of dairy products.

We used an approach inspired by hedonic price models, where a product is considered as a bundle of attributes and its observed price is a linear combination of these, with the weights of the attributes representing their implicit prices (Rosen, 1974). There is a broad literature about hedonic models applied to different food products (Loureiro & McCluskey, 2000; Troncoso & Aguirre, 2006; Costanigro & McCluskey, 2011), including dairy products (Gillmeister *et al.*, 1996; Smith *et al.*, 2009; Carlucci *et al.*, 2013; Loke *et al.*, 2015; Bimbo *et al.*, 2016), but none of these studies has focused on value-added products processed and sold by dairy farms. To the best of our knowledge this paper is the first to identify the separate effect of each attribute on the margin (income minus variable cost), which allows evaluating the profitability achievable by adopting different strategies (Carlucci *et al.*, 2013).

The product attributes were selected based on both, the most-used attributes reported in the agri-food marketing literature on consumer preferences (*e.g.* Jiménez-Guerrero *et al.*, 2012) and the opinion of 25 Spanish experts possessing in-depth knowledge of the dairy sector. Previous research has found a positive and significant relationship between the consumer's purchase decision and attributes such as certified PDO (Fandos & Flavián, 2006), organic labelling (Gil *et al.*, 2000), or presentation format (Draskovic, 2010). More specifically, studies about dairy products, such as cheese, have found that the main attributes affecting preferences for this product are price, texture, size of the sales unit, PDO certification, ripeness (Tendero & Bernabéu, 2005) and color and packaging design (Eldesouky & Mesias, 2014).

However, it should be noted that attributes of agri-food products refer not only to the physical properties of the product (intrinsic qualities) but also to the conditions under which the latter is produced, distributed and retailed (extrinsic qualities) (Kirwan, 2006). Direct marketing strategies (DMS) include, for example, direct retailing to end consumers, restaurants or grocery stores. This strategy allows a farm operator to capture a larger share of the consumers' food income budget by eliminating the intermediary in the supply chain (Detre *et al.*, 2011). Indeed, previous research has suggested that farmers involved in DMS are more likely to achieve higher income levels (Govindasamy *et al.*, 1999; Balogh *et al.*, 2016).

In accordance with the above, in the present work we considered three product categories (milk, cheese, yogurt) and nine attributes of each product, namely milk-type composition, yield, organic labeling, PDO certification, maturation period, expiration period, size of the sales unit, returnable packaging and distribution channel.

Material and methods

Product profitability measure

We performed an economic analysis of the transformation and commercialization of dairy products by valuing the incremental income and costs generated by these activities with respect to the primary production of milk. We used the margin per liter of milk (ML) as the profitability measure of the transformed product. To obtain the ML, we first calculated the margin per unit of product, defined as price minus variable cost (Horngren *et al.*, 2016). There are three main different sources of variable cost: the raw milk, other raw materials (rennet, ferments, salt, rice, fruit, etc.) and packaging. In most cases the milk used is produced on the farm, so that the cost of milk is the price that the farm would have obtained by selling the milk to a processor (the opportunity cost). The cost of the direct materials acquired from external suppliers is valued at the acquisition cost.

To ensure comparability of products with different milk content and size of the sales unit, we divided the margin per unit by the liters of milk in each unit, obtaining the ML which indicates the value added per liter of milk.

$$\mathrm{ML} = \frac{\text{Price per unit of product - Variable Cost per unit of product}}{\text{Liters of milk per unit of product}}$$

Moreover, we can express ML as the difference between income per liter (IL) and variable cost per liter (VCL).

$$\mathrm{ML} = \frac{\text{Price per unit of product}}{\text{Liters of milk per unit of product}} - \frac{\text{Variable Cost per unit of product}}{\text{Liters of milk per unit of product}} = \mathrm{IL} - \mathrm{VCL}$$

In this way, it will be possible to determine whether the effect of the explanatory variables on the ML is due to their influence on income or to their effect on variable costs.

It should be noted that our approach, focused on the ML analysis, guarantees the comparability of product margins because we avoid allocating indirect and fixed costs (Goldratt, 1990), which always implies some degree of subjectivity.

Sample and data

Although in the Spanish dairy sector most of the production is sold directly to the processing industry, some farms have embarked upon diversification strategies. No specific register exists for dairy farms that perform production and commercialization of dairy products. For this reason, we resorted to identifying them via enquiries to different agents of the dairy sector (cooperatives, advisors, producer organizations, regulatory organisms of the different PDOs and organic agriculture, etc.). Our study centered on the four regions of Northern Spain (Asturias, Cantabria, Galicia and the Basque Country) where 79% of the dairy farmers and 59% of Spanish dairy production were located in 2012 (MAPAMA, 2016). Collaboration was requested from the 80 cases identified, and the participation of 49 farms was obtained, 14 of which are certified as organic with the remainder being conventional.

The study benefited from the collaboration of a group of 25 Spanish experts possessing in-depth knowledge of the dairy sector (farm advisers, scientists, farm union staff, representatives from government, policy-making, supply chains or rural economic development areas, etc.), who provided their opinion with respect to the factors to be considered in evaluating the success of these types of farm diversification initiatives. For these experts, the most important factors were the management ability of farmers and the differentiation of their production within the market via various strategies such as packaging, direct contact with consumers, sales in specialized shops, PDO, an organic label, and the attributes of the local and traditional product. This assessment by the experts was very useful for the elaboration of the questionnaire that was used during 2012 in order to collect the data for this study through face to face interviews.

The data collected, which refer to 2011 can be briefly described as follows:

– The median quantity of processed milk per farm is 280,000 liters. Approximately 50% of the sample transforms more than 40% of the milk produced by the herd, with 24% of the sample requiring external procurement of milk.

– The average sales structure by product type indicates that cheese represents 61% of total sales, liquid milk 26%, and yogurt 13%.

– The analysis of distribution channels reflects that direct sales to consumer represents 29.8% of total sales, grocery stores 33.1%, restaurants 23.9%, and large retail distribution 13.2%.

– The average investment dedicated to transformation and commercialization of dairy products amounts to € 258,500 per farm, 76% of which is allocated to assets related with milk transformation and 24% to the commercialization of products.

– The average number of workers per farm is 4.8, 1.7 of which are dedicated to livestock activity and the rest to activities related to the transformation and commercialization of products (representing 64% of employment in these farms).

– Cow milk represents 85.3% of the milk used for the elaboration of the different products, the remainder being either goat or sheep milk.

– Of all the references sold in the farms, 16.6% possessed a PDO label, accounting for 31.8% of the total sales in our sample.

Apart from the price and direct variable cost of each product and fixed costs for transformation and commercialization activities in each farm, our database includes several variables that may explain product profitability. We classified these into product types, attributes of each product and control variables (Table 1).

Table 2 shows some descriptive statistics of the variables used in the empirical analysis, which correspond to a total of 265 products manufactured and marketed by the 49 collaborating farms. The number of products by farm oscillates between 1 and 16. We considered only three classes of products but we distinguished between natural yogurt and yogurt with fruit. Also, given that the margin per liter may depend on size, we considered different sizes of the same product as different products.

Cheese products represent two thirds of all products in the sample, while the least represented one is yogurt. From Table 2, it is clear that cow milk is by far the most used input in the production processes of value-added products, while sheep milk is the least utilized. Organic production, PDO, and returnable packaging are product characteristics that are not very common in the sample. Sales are almost equally distributed among direct selling, restaurants and grocery stores, with only 13.2% in large retail firms. Family labor represents more than half of total labor. As for geographical location, almost 70% of products are processed in Galicia and Asturias.

Econometric model

As mentioned above, the model used in this study resembles the hedonic price model in which the price of the product is assumed to depend on several product attributes (Rosen, 1974). However, in this study the dependent variables were the margin, income and variable costs per liter. As such, the ML was assumed to depend both on product characteristics and control variables. The equation to be estimated is:

Table 1. Product types, attributes and control variables

Product types
Milk, cheese, yogurt (dummy variables)
Product attributes
Milk-type composition: % cow milk, % sheep milk, % goat milk
Yield: liters of milk per kilogram of product
Organic labeling (dummy)
Certified with protected designation of origin (PDO) (dummy)
Maturation period (days)
Expiration period (days)
Size of the sales unit: kg per unit of product
Packaging: returnable (dummy)
Distribution: % direct-to-consumer sales, % restaurants sales, % grocery stores sales, % large retail sales
Control variables
Region: Galicia, Asturias, Cantabria, Basque Country (dummy variables)
Proportion of family labor over total labor
Liters of milk: volume of liters of milk processed in each product

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.
Income per liter (IL) (€)	1.575	0.981	0.558	6.875
Variable cost per liter (VCL) (€)	0.629	0.394	0.269	2.663
Margin per liter (ML) (€)	0.946	0.688	0.090	4.553
Milk (dummy)	0.128	0.335	0	1
Cheese (dummy)	0.679	0.468	0	1
Yogurt (dummy)	0.192	0.395	0	1
% Cow milk	0.853	0.326	0	1
% Sheep milk	0.022	0.138	0	1
% Goat milk	0.126	0.301	0	1
Milk per kg (L)	5.793	3.730	0.87	12
Organic (dummy)	0.283	0.451	0	1
Protected designation of origin (PDO) (dummy)	0.166	0.373	0	1
Maturation period (days)	21	31	1	180
Expiration period (days)	139	151	4	365
Size of the sales unit (kg per unit)	1.333	2.549	0.08	25
Returnable packaging (dummy)	0.030	0.171	0	1
% Direct sales	0.298	0.329	0	1
% Restaurants sales	0.239	0.327	0	1
% Grocery stores sales	0.331	0.330	0	1
% Large retail sales	0.132	0.267	0	1
Galicia (dummy)	0.325	0.469	0	1
Asturias (dummy)	0.370	0.484	0	1
Cantabria (dummy)	0.155	0.362	0	1
Basque Country (dummy)	0.151	0.359	0	1
% Family labor	0.542	0.338	0	1
Liters of milk	43,611	163,958	100	2,514,015

$$\mathrm{ML_i} = \alpha + \sum_1^j \beta_j x_{ji} + \sum_1^k \delta_k z_{ki} + \varepsilon_i \quad [1]$$

where i indexes products, ranging from 1 to 265, j denotes product types and attributes, and k indicates control variables; x is a set of variables representing product types and attributes, z are control variables, β and δ are the parameters to be estimated, and finally, ε is the error term. Since ML is the difference between income per liter (IL) and variable cost per liter (VCL), equation [1] was also estimated using these two variables as dependent variables (see equations [2] and [3]). In this way, it will be possible to determine whether the effect of the explanatory variables on the ML is due to their influence on income or to their effect on variable costs.

$$\mathrm{IL_i} = \alpha + \sum_1^j \beta_j x_{ji} + \sum_1^k \delta_k z_{ki} + \varepsilon_i \quad [2]$$

$$\mathrm{VCL_i} = \alpha + \sum_1^j \beta_j x_{ji} + \sum_1^k \delta_k z_{ki} + \varepsilon_i \quad [3]$$

Specifically, the x vector includes a set of dummies that indicate whether the product type is cheese or yogurt (the excluded category is liquid milk) as well as the following product attributes: proportion of sheep milk in the production of the good, proportion of goat milk (the proportion of cow milk is excluded), liters of milk per kg of product (yield), two dummy variables indicating whether the product is organic or is certified with a PDO, days of maturation in the production process, days of product expiration, the size of the sales unit (measured in kg) and a dummy variable indicating if the packaging is returnable or not. Finally, the distribution channel was considered by including the proportion of sales direct to the end consumer, to restaurants, and to grocery stores (the proportion sold to large retail firms is excluded). It is worth noting that the PDO characteristic was only observed for cheese. Although we have not presented it in the results, we have also considered the interactions between the type of product and the variable "organic" but no significant difference was found for the effect of this variable with regard to any of the three types of product.

The control variables included in the analysis were a set of regional dummy variables indicating whether the farm is located in Asturias, Cantabria or the Basque Country (Galicia is the excluded region), the proportion of family labor over total labor and the liters of milk processed in each product.

We did not include farm fixed effects in our estimation since the variable "proportion of family labor over total labor" varies across farms but not across products, and therefore it was perfectly correlated with a farm fixed effect.

Results

Regression analysis

The three equations were estimated by ordinary least squares. Table 3 shows the estimated parameters. The R-squared shows that the variables included in the empirical analysis explain between 71% and 83% of the variation in the dependent variables, which can be considered as an acceptable explanatory power, given the high degree of heterogeneity across farms and products in the sample.

Compared to liquid milk, any of the other products included in the sample generated a larger ML. In particular, cheese generates larger income and lower costs, while yogurt generates a positive impact on the ML due to a larger effect on income than on variable costs. While the proportions of sheep and goat milk increased both IL and VCL, only sheep milk exerted a positive impact on the ML. Thus, the higher cost of goat milk (compared to cow milk) was almost exactly transferred to IL, thereby generating a null influence on ML. However, the impact of sheep milk content on income was larger than its effect on variable costs, which generates a positive impact on ML. The quantity of milk per kg of product had a negative influence on ML due to its negative impact on income. Therefore, the larger the milk content, the lower the profitability of the product.

Organic production did not generate a larger ML, as the higher IL was offset by the greater cost of materials. Even when the impact on both income and cost of having a PDO was somewhat unclear, its effect on ML was clearly positive, which emphasizes the importance of a quality indicator such as this. The maturation period was not significant in explaining any of the three dependent variables. The expiration period, on the other hand, showed a positive impact on the ML, which was due to its influence on income given that its effect on variable costs was not significant.

The size of the sales unit exerted a small impact on costs but its effect on the ML was not significant. This seems to indicate that this variable is not an important aspect in determining the profitability obtained from any kind of product.

Returnable packaging had a negative impact on variable costs, as expected, but it failed to generate a significant effect on the ML. Hence, from an economic point of view the use of returnable packaging did not seem to be important.

Looking at product distribution, the most profitable method was direct selling to end consumers, which generates larger income and lower costs than large-

Table 3. Estimation results

Variable	Margin per liter (ML)			Income per liter (IL)			Variable cost per liter (VCL)		
	Coef.	*t*-stat.	*p* value	Coef.	*t*-stat.	*p* value	Coef.	*t*-stat.	*p* value
Constant	0.012	0.10	0.917	0.588***	4.07	0.000	0.576***	7.54	0.000
Cheese (dummy)	0.688***	5.70	0.000	0.517***	3.49	0.001	-0.171**	-2.18	0.030
Yogurt (dummy)	1.518***	17.71	0.000	2.153***	20.46	0.000	0.635***	11.41	0.000
% Sheep milk	0.624***	3.88	0.000	1.464***	7.42	0.000	0.840***	8.04	0.000
% Goat milk	-0.007	-0.08	0.937	0.263**	2.35	0.020	0.270***	4.56	0.000
Milk per kg	-0.100***	-5.42	0.000	-0.091***	-4.04	0.000	0.009	0.71	0.478
Organic (dummy)	0.020	0.35	0.730	0.118*	1.66	0.099	0.098***	2.60	0.010
PDO (dummy)	0.179**	2.33	0.020	0.118	1.25	0.213	-0.061	-1.23	0.220
Maturation period	0.002	1.42	0.156	0.002	1.15	0.250	0.000	-0.01	0.993
Expiration period	0.001***	3.70	0.000	0.001**	2.36	0.019	0.000	-1.24	0.217
Size of the sales unit	0.007	0.70	0.488	-0.005	-0.43	0.667	-0.012*	-1.89	0.061
Ret. packaging (dummy)	0.207	1.48	0.140	-0.048	-0.28	0.781	-0.255***	-2.81	0.005
% Direct sales	0.421***	4.18	0.000	0.289**	2.34	0.020	-0.132**	-2.02	0.045
% Restaurants sales	0.264**	2.58	0.011	0.199	1.58	0.116	-0.066	-0.99	0.325
% Grocery stores sales	0.413***	4.05	0.000	0.431***	3.44	0.001	0.018	0.28	0.783
Asturias (dummy)	0.099	1.38	0.169	0.158*	1.80	0.074	0.059	1.27	0.206
Cantabria (dummy)	-0.197**	-2.51	0.013	-0.246**	-2.55	0.011	-0.049	-0.96	0.337
Basque C. (dummy)	0.207***	2.60	0.010	-0.001	-0.01	0.990	-0.208***	-4.02	0.000
% Labor family	0.259***	3.17	0.002	0.356***	3.55	0.000	0.097*	1.82	0.069
Liters of milk	0.000	-0.47	0.638	0.000	-0.55	0.583	0.000	-0.31	0.753
R-squared		0.78			0.83			0.71	

PDO: Protected designation of origin. ***significant at 0.01 level; **significant at 0.05 level; *significant at 0.1 level.

scale distribution (which is the category omitted in the estimated equations). The largest impact on income was generated by stores sales, but costs were similar to those associated with large-scale distribution and also, its impact on ML seems to be almost equal than that obtained by direct selling. Restaurant selling also generated a larger ML than large retail firms.

Looking at the geographical localization of the business, producers in Asturias did not generate a larger ML than those located in Galicia. Products made in Cantabria are less profitable than those made in Galicia, which is due to the lower income achieved as there was no difference in variable costs. Products made in the Basque Country, on the other hand, are more profitable due to lower variable costs than those made in Galicia. Family businesses seem to generate larger margins due to the larger income earned given that the proportion of family labor has a positive impact on both variables.

Finally, while the amount of liters of milk – which is related to the amount of milk transformed for each product – could have a negative effect on IL because of possible discounts to stimulate larger volumes of sales, the results show that this variable does not have any significant effect on the dependent variables.

Coverage of fixed costs and break-even point

The profitability of dairy farm diversification ventures does not only depend on the ML of the products: a complete analysis of profitability requires taking into account the fixed costs related to processing and marketing activities. Unfortunately, we could not obtain information for allocating fixed costs to products. Therefore, in order to explore the farms' profitability, we analyzed three different types of business according to the set of outputs produced. In particular, we considered ventures that only produce cheese (19 cases), those that only produce fluid milk (6 cases) and those that produce fluid milk, cheese and yogurt (5 cases).

We assumed that, in the short-term, all transformation and commercialization costs are indirect and fixed, so that they are grouped together under the heading "fixed costs". Labor, the depreciation of fixed assets and other general costs were also considered as fixed costs. Labor cost was determined as the product of the average cost of labor (salary and social costs per worker) and the number of employees, both hired workers and family members.

As investments for the manufacture of products, we considered buildings, facilities, machinery and tools, and as investments for marketing and distribution we considered vehicles, sales outlets and vending machines. The investments in fixed assets were depreciated over their working life (20 years for buildings and 10 years for the remaining elements). In order to perform an economic analysis using current values, the costs of depreciation were determined applying current cost accounting to investments based on their current acquisition value (taking into account the evolution of the Spanish Consumer Price Index).

Table 4 shows for each venture type the average fixed transformation and commercialization costs, the average quantity of milk transformed, the average ML for the mix of products sold and the break-even point, calculating the quantity of milk that must be transformed to cover the transformation costs, the commercialization costs and also the total fixed costs (transformation + commercialization). From Table 4, it was clear that total fixed costs were highest for milk producers, although the three types of ventures considered showed large differences in the fixed cost structure between transformation and commercialization costs. Transformation costs per liter of milk were lowest for businesses producing fluid milk (0.226 €/L) and highest for those producing milk, cheese and yogurt (0.396 €/L), as was to be expected. Fixed commercialization costs per liter in milk ventures (0.284 €/L) were higher than in the other two types of ventures due to strong investments in vending machines.

From our calculations, 91%, 62% and 78% of the milk transformed were required to fully cover total fixed costs in each of the venture types respectively. These results show the importance of the ML generated by the products for the profitability of these ventures and at the same time highlight that a certain volume of production was needed in order to cover fixed costs and generate profits. In the sample studied, the businesses which only produce liquid milk showed the worst results, given that they generate a lower ML and require the greatest volume of production in order to achieve the break-even point. This was due especially to the higher fixed costs of commercialization.

Discussion

The empirical analysis measures the income and the costs associated with several key attributes of dairy products, which provide insights into the benefits of different farmer's strategies. Our results indicated that elaboration of value-added dairy products was a profitable diversification strategy for the dairy farms analyzed. Our findings reveal the important impact on profits of some decisions related to the types of products to be elaborated and commercialized. Cheese and yogurt were products that generate larger ML than liquid milk. Attributes such as milk-type composition, PDO, expiration period and DMS had a positive influence on profitability. These findings help to explain why certain holdings with reduced amounts of transformed milk obtain similar profits, or higher, than others which manage larger volumes of milk but which have lower ML.

Next, we explain in more detail some of the effects found in the empirical analysis.

We have found that organic labelling did not have an impact on product profitability. Different studies showed that organic labelling has a positive impact on the price of dairy products for a variety of reasons, including the perceptions of consumers about the health and environmental benefits from organically produced foods and other quality attributes such as freshness and taste (Smith *et al.*, 2009; Loke *et al.*, 2011; Carlucci *et al.*, 2013; Bimbo *et al.*, 2016). Although our results show that organic products generated greater IL, they also had greater VCL, which created a non-significant effect on ML. When interpreting these results it should be taken into account that prior to the transformation and commercialization of the products, many organic holdings were receiving a price premium resulting in a milk price (0.39 €/L) higher than the price for conventional milk (the average selling price to industry is 0.32 €/L in the sample). This premium in the value of organic milk implied a greater cost for the products elaborated in these farms.

Table 4. Liters to cover fixed costs by venture types

Variable	Milk producers	Cheese producers	Milk, cheese and yogurt producers
Fixed transformation costs (€) (a)	48,908	65,540	52,817
Fixed commercialization costs (€) (b)	61,477	35,310	30,118
Milk transformed (L) (c)	216,167	235,953	133,510
Margin per liter (ML) (€/L) (d)	0.558	0.690	0.798
Fixed transformation costs per liter (€/L) (a/c)	0.226	0.278	0.396
Fixed commercialization costs per liter (€/L) (b/c)	0.284	0.150	0.226
Liters to cover fixed transformation costs (a/d)	87,633	94,944	66,178
Liters to cover fixed commercialization costs (b/d)	110,154	51,152	37,737
Liters to cover fixed costs [(a+b) / d]	197,787	146,096	103,916

On the other hand, and as expected, PDO certification had a clear positive effect on profitability, emphasizing the importance of this quality indicator. Since the PDO label is an instrument that reduces the asymmetric information problem between producers and consumers, if the collective reputation of the product is good this label will be a powerful tool for signalling quality (Loureiro & McCluskey, 2000). In the context of the present work, one should take into consideration that the PDO variable refers to various denominations of origin of cheese with heterogeneous prices, costs and margins. Dummies for each PDO were not used given the reduced number of cases for some of them.

In relation to the size of the sales unit, several papers find a negative effect on the price of the dairy products (Smith *et al.*, 2009; Carlucci *et al.*, 2013) but in our analysis this effect of the container size on IL was not significant.

Regarding the distribution channel of the product, our results showed that some DMS were more profitable than sales through large retailers. This result seems to be in line with previous investigations which found that sales to local grocery stores, restaurants, and/or other retailers and regional distributors had quite a significant positive impact on gross cash income (Uematsu & Mishra, 2011). The negative effect of direct sales on the VCL should be emphasized, which was due to some extent to the use of vending machines for liquid milk. In these cases, consumers used their own bottles and the farm saved the packaging costs.

Concerning the control variables, we found that family businesses seem to generate larger margins. This result could be related to the strategies based on establishing face-to-face links between the producers and consumers, in which authenticity and trust are mediated through personal interaction (Kirwan, 2006).

In those farms with a greater share of family labor there appears to exist a greater commitment on the part of the personnel to give value to the products elaborated, incorporating intangible elements which contribute to consumers perceiving more value. Indeed, it was observed that in the holdings with a greater percentage of family labor, more initiatives exist that favor direct communication with the customer (agro-tourism, guided tours to farms, etc.). We understand that farms with these initiatives seek to advertise their activity with a view to generating a good reputation in the eyes of current and future customers by attempting to differentiate themselves via intangible features such as the history of the farm, the natural and cultural elements which characterize it and the ‘rural’ experiences provided to visitors.

With respect to the geographical localization of the businesses, our results show that profitability varies among regions. This is an expected result given that the dairy sector is not homogeneous across the Cantabrian coast.

In our study transformation and commercialization costs (including labor costs, equipment amortization and other fixed costs) were not included in the variable costs used to calculate the ML. Therefore, in order to study the profitability of these activities we undertook an additional analysis by defining three types of ventures and by using average fixed costs of transformation and commercialization by each type (milk; cheese; milk, cheese and yogurt). The results of this analysis show important differences in the average ML as well as in the coverage of fixed costs and thus in the generation of profit. After considering the fixed costs of transformation and commercialization, we observe that the ventures which only produce liquid milk required most of their production (91%) in order to cover costs, resulting in reduced profits, while those that produce cheese obtained better results, requiring on average 62% of their production to cover costs with the remaining 38% contributing directly to operating profit.

We consider that the results of the study can be useful in the context of farm advisory services in order to give advice to those farmers who plan to start a diversification venture. The farmers interested in the initiatives of milk transformation and commercialization must adequately manage the factors which determine profitability.

Finally, this work suffers from a number of limitations and there are possible lines of development that should be considered in future research. In particular, our sample of farms is small and the data are for only one year, so the results should be interpreted with due caution. Future studies should analyze the profitability and contribution of the products over a larger time span. A more detailed analysis of product profitability also requires obtaining the additional information with which to assign indirect and fixed costs to the products and at the same time allow an adequate separation of fixed costs related to production and sub-activity.

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