

# Structure and concentration of the global sheep meat market

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**ABSTRACT** - The objective of this study was to examine the structure and competitiveness of the global sheep meat market using econometric indices (Balassa's revealed comparative advantage, relative position market [RPM], relative export advantage [RXA], imported specialization index [RMA], relative trade advantage [RTA], and net export index [NEI]), as well as sheep meat production, structure, consumption, and trade volume for 151 countries with sustained participation in the global trade market for sheep meat from 2003 to 2013. A hierarchical cluster analysis was used to classify countries. We observed that structure, production, and imports of sheep meat were unconcentrated, e.g., there is no country dominating for those indices; in contrast, the export market was highly concentrated with a duopolistic structure. For trade competitiveness, New Zealand, the Republic of Macedonia, and Sudan were competitive and specialized, while New Zealand and Australia were dominant in the international trade market. The global sheep meat market has become more concentrated, as it has developed as a specialized market. Therefore, there is a need for a holistic vision and understanding of the global sheep meat market so that its impact on farmers can be foreseen.

**Keywords:** Balassa's index, HHI, revealed comparative advantage, trade

## Introduction

Sheep meat production is reported in 188 countries, and this meat is primarily consumed on special occasions (de Andrade et al., 2016) and for religious purposes, e.g., the Muslim population (Montossi et al., 2013). In 2017, more than 567 million sheep were slaughtered around the world (FAO, 2019), and sheep meat is an important product in the global meat market (Hejazi et al., 2019), with an expanding demand satisfied by imported meat (Firetti et al., 2018). For decades, Australia and New Zealand have been the major players in the global sheep export market (Boutonnet, 1999; Colby, 2015), and China the major importer (Colby, 2015), as a result of bilateral free-trade agreements with Australia in 2015, with New Zealand in 2008, and with Chile in 2003, reducing its dependence on imports from other countries (Hejazi et al., 2019). In the global sheep meat industry, the level of corporate expansion and market power among meat industry companies seems lower than for other species, in which large private companies both operate in and sell to multiple countries (Belk et al., 2014).

In an industry, market structure and conduct are related; thus, a more atomistic structure is preferable to a monopolistic structure. As an industry becomes more concentrated, companies have enough power

and resources to influence the market, reducing the its competitive performance (Ipek and Ipek, 2018). This phenomenon is known as the structure-conduct-performance paradigm (Yi et al., 2018). Several studies regarding market structure and competitiveness at the global trade level exist (Pereira et al., 2013; Chatellier, 2017), yet there are no studies that focus on sheep meat. Trade competitiveness is the comparative advantage measured by export and import indices (Latruffe, 2010).

There are several indices available for measuring trade competitiveness and specialization: Balassa's revealed comparative advantage (RCA) (Bojnec and Fertő, 2015), the relative position market (RPM) index (Lafay, 1987), the relative export advantage (RXA) (Vollrath, 1991), and the net export index (NEI) (Balassa and Bauwens, 1988). Relying exclusively on one index might lead to misconceptions regarding a country's comparative advantage; therefore, it is common to use complementary indices.

The objective of this investigation was to examine the structure and competitiveness of the global sheep meat market using econometric indices for 151 countries with sustained participation in the global trade market for sheep meat, from 2003 to 2013. Results revealed the need for a holistic vision and understanding of the global sheep meat market so that its impact on farmers can be foreseen.

## Material and Methods

Data on sheep meat production (SMP) in tons (the items of the FAO database used were: 867, 977, 1017, 1035, 1038, 1058, 1069, 1073, 1080, 1097, 1108, 1141, 1163, 1164, and 1666), exports (ESM), and imports (ISM) were retrieved from the Food and Agriculture Organization of the United Nations (FAO, 2019) for all nations, for the 2003 to 2013 period. "World data" included the total world trade of all goods. Data for each country's total trade was obtained from the World Trade Organization (WTO, 2017).

The per capita consumption index (PC) of each country was calculated as the mean consumption of sheep meat per person (kg/year). Data regarding population were also retrieved from the FAO (2019). The average annual growth rate for meat production (SMPAGR) and the average annual per capita consumption (PCAGR) were also calculated, as they were considered indicators of stability in production and consumption per country. The definitions of both follow:

Annual growth rate for sheep meat production (PAGR):

$$PAGR = \left[ \frac{SMP_{k+1} - SMP_k}{SMP_k} \right] \times 100 \quad (1)$$

in which  $SMP_{k+1}$  ( $k = 1, \dots, 10$ ) represents the sheep meat production for the present year, and  $SMP_k$  the sheep meat production for the previous year of country  $j$ .

Average annual growth rate for sheep meat production (SMPAGR):

$$SMPAGR_j = \sum_{k=1}^9 \frac{PAGR_k}{9} \quad (2)$$

in which PAGR represents the annual growth rate for the sheep meat production of the country  $j$  from year differences ( $k = 1, \dots, 9$ ).

Per capita consumption (PC) was calculated as:

$$PC_j = \frac{(SMP_j + ISM_j) - ESM_j}{Pop_j} \quad (3)$$

in which SMP represents production, ISM imports, and ESM exports of sheep meat, and Pop the number of inhabitants for country  $j$ .

Annual growth rate of per capita consumption (PCA):

$$PCA = \left[ \frac{PC_{k+1} - PC_k}{PC_k} \right] \times 100 \quad (4)$$

in which  $PC_{k+1}$  represents the per capita consumption of the present year, and  $PC_k$  the per capita consumption of the previous year of the country  $j$ .

Average annual growth rate of the per capita consumption (PCAGR):

$$PCAGR_j = \sum_{k=1}^9 \frac{PCA_k}{9} \quad (5)$$

in which  $PCA$  represents the annual growth rate of the per capita consumption of the country  $j$  from year differences ( $k=1, \dots, 9$ ).

The Herfindahl-Hirschman Index (HHI), is a structure index, a statistical measure of market concentration, which is defined as follows:

$$HHI = \sum_{i=1}^n (MS_i)^2 \quad (6)$$

in which  $MS_i$  is the market share of the country  $i$  and  $n$  are the countries in the market. The market share was calculated with the SMP of each country (Greco, 2000).

Several competitiveness indices were used: RCA, RPM, RXA, RMA, RTA, and the NEI index. The RCA index is defined as the ratio of a country's exports of a particular commodity to its share of total merchandise exports (Balassa and Bauwens, 1988):

$$RCA = \frac{\frac{x_{ij}}{\sum_i x_{ij}}}{\frac{\sum_i x_{ij}}{\sum_i x_i}} \text{ for } i = 1, 2, \dots, I; j = 1, 2, \dots, J. \quad (7)$$

in which  $X_{ij}$  represents the exports of product  $j$  of country  $i$ ,  $\sum_i X_{ij}$  represents the total exports of country  $i$ ,  $\sum_i X_j$  represents the exports of product  $j$  in the world, and  $\sum_i X_i$  represents the total world exports.

The RPM index is used to determine the position that a nation holds regarding the global trade of a product. It is calculated as follows:

$$RPM_{ij} = 100 \left[ \frac{X_{ij} - M_{ij}}{X_{iw} + M_{iw}} \right] \quad (8)$$

in which  $X$  represents the exports and  $M$  represents the imports of a product ( $i$ ) of country  $j$  or world trade ( $w$ ).

The indices RXA, imported specialization index (RMA; which considers imports, thereby avoiding the double counting issue), and relative trade advantage (RTA) (which is the difference between the RXA and RMA) were also considered (Vollrath, 1991; Bojnec and Fertő, 2009). A set of commodities included all exported/imported meats except for sheep (Bojnec and Fertő, 2015) and was used to calculate these indices using the following equations:

$$RXA = \frac{\frac{x_{ij}}{\sum_i x_{ni}}}{\frac{\sum_i x_{ir}}{\sum_n \sum_r x_{nr}}} \quad (9)$$

$$RMA = \frac{\frac{M_{ij}}{\sum_i M_{nj}}}{\frac{\sum_i M_{ir}}{\sum_n \sum_r M_{nr}}} \quad (10)$$

in which  $X$  represents the exports and  $M$  represents the imports of sheep meat ( $i$ ) of country  $j$ ,  $n$  represents the rest of the meats, and  $r$  represents the rest of the countries.

The RTA index, which considers exports and imports simultaneously, is calculated as follows:

$$RTA = RXA - RMA \quad (11)$$

To assess competitiveness based on exports and imports, the NEI was calculated. This index considers a nation's trade balance divided by the total value of trade (Banterle and Carraresi, 2007):

$$NEI_{ij} = \frac{(X_{ij} - M_{ij})}{(X_{ij} + M_{ij})} \quad (12)$$

in which  $X$  represents the exports and  $M$  represents the imports of product ( $i$ ) of country  $j$ .

To better understand the indices, it should be considered that if country  $i$ 's market share in product  $j$ 's export market is larger than its market share in the world export market, then the RCA is  $>1$ , and this country has a revealed comparative advantage in producing product  $j$ . Otherwise, when the RCA is  $<1$ , then the country possesses a comparative disadvantage in product  $j$  (Lee, 2011). In the case of the RPM index, the higher its value, the greater the position a nation has in the global market (Thomé and Soares, 2015; Magaña Magaña et al., 2017). Values greater than 100 for the RXA and RMA indices reveal the country's specialization in exports/imports for that sector, in this case, the meat sector. In contrast, values lower than 100 indicate that the country is not specialized in that sector, and no comparative advantage is revealed (Banterle and Carraresi, 2006). Therefore, if RTA is  $>0$ , then a relative trade advantage is revealed; RTA = 0 refers to all those countries at a break-even point without a relative trade advantage or a relative trade disadvantage, and RTA  $<0$  indicates a relative trade disadvantage (Bojnec and Fertő, 2015). Finally, with regard to the NEI, values are between  $-1$  (if a nation only imports) and  $+1$  (if a nation only exports), and zero means equality (Banterle and Carraresi, 2007).

It is assumed that the presence of substantial and sustained exports and participation in the market are better indicators; therefore, only countries with complete data for the analyzed period were considered; information for 151 countries was retained. Due to data variability, the mean value for the analyzed period was used for all variables (Lee, 2011).

To understand competitiveness, a cluster analysis was performed, considering trade indices, as well as sheep meat data for production, consumption, and trade. A total of 12 variables were used for the statistical analyses (Table 1). The HHI index was excluded from this analysis due to the high level of correlation with the indices RCA ( $r = 0.939$ ,  $P < 0.01$ ) and RPM ( $r = 0.895$ ,  $P < 0.01$ ). A hierarchical cluster analysis in accordance with Ward's method using the squared Euclidean distance was used to classify the countries into different clusters; statistical analyses were performed using SAS (Statistical Analysis System, version 9.4). Cluster analysis is common for this type of research (Pereira et al., 2013). The number of clusters was determined based on an  $R^2 > 0.8$  (SAS, 1989).

Although the technique enables the grouping of countries based on their characteristics (Latruffe, 2010), these groups needed to be validated. Therefore, data were subjected to analysis of variance (MANOVA) and mean comparison was performed using Tukey's test at 5% (statistical analysis was performed using SPSS 22.0 for Windows®, SPSS Inc., Chicago, IL, USA); this procedure also allowed for the profiling of the resulting groups.

**Table 1 - Variables used for the hierarchical cluster analysis**

Concept	Variable	
Competitiveness	RCA; RPM; RXA; RMA; RTA; NEI	Balassa's revealed comparative advantage; relative position market; relative export advantage; imported specialization index; relative trade advantage; net export index
Sheep meat production	SMP; SMPAGR	Sheep meat production; sheep meat production annual growth rate
Sheep meat consumption	PC; PCAGR	Per capita consumption; per capita consumption annual growth rate
Sheep meat trade	ISM; ESM	Imports of sheep meat; exports of sheep meat

## Results

During the study period, 188 countries reported producing sheep meat, 184 reported importing sheep meat, and 118 reported exporting sheep meat, yet only 151 countries had substantial and sustained exports and participation in the market. Hence, only 151 can be considered participants in the global sheep meat market or production. The top five countries concentrated 45% of the global sheep meat production (China, Australia, New Zealand, Iran, and the United Kingdom), 50% of the imports (France, United Kingdom, USA, China, and Saudi Arabia), and 75% of the exports (New Zealand, Australia, United Kingdom, Ireland, Belgium) (Table 2). The mean HHI value for the global export market was 2,473, but it was over 2,500 for half of the period.

A total of 12 clusters were obtained by the hierarchical analysis; eight had more than one country (Table 3). New Zealand (CL 10), the Republic of Macedonia, and Sudan (CL 8) were the most competitive countries as they had a competitive advantage in five indices (RCA, RPM, RXA, RTA, and NEI), with New Zealand dominating the international export market (ESM) (Table 4). Algeria and Libya (CL 6) had a competitive advantage for sheep meat imports (only RMA). The clusters with competitive advantages in four indices can be divided into two subgroups: the country that was not specialized in exporting sheep meat (Australia, CL 9) and the countries that had a competitive advantage in trade but did not have relevance at the international trade level (Argentina, Bulgaria, Chile, Colombia, India, Iran, Ireland, Kyrgyzstan, Kenya, Republic of Moldova, Namibia, Netherlands, Pakistan, Paraguay, Romania, Slovakia, Spain, Turkey, Uruguay, Zambia, CL 3).

The cluster with a competitive advantage in two indices (RCA and RTA) was made up of countries that import more than what they export in sheep meat but which still have a revealed comparative

**Table 2 - Market share of the top five countries (%) and Herfindahl-Hirschman index (HHI) for the sheep meat market (production, import, and export), 2003-2013**

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
HHI production	717	721	717	765	809	771	795	814	777	767	770
China	22	23	22	24	24	24	25	25	24	24	24
Australia	8	7	7	8	8	8	8	7	6	7	8
New Zealand	7	7	7	7	7	7	6	6	6	5	6
Iran	4	4	4	3	3	2	1	1	1	1	2
United Kingdom	4	4	4	4	4	4	4	3	4	3	3
Others (183)	55	56	55	55	54	56	57	58	59	59	58
HHI import	688	680	622	593	577	558	615	601	642	693	1025
France	16	15	14	14	13	13	13	13	13	12	10
United Kingdom	13	13	12	12	12	11	12	11	10	10	9
USA	8	8	8	8	8	7	7	7	8	7	6
China	7	7	7	7	8	8	10	11	14	17	27
Saudi Arabia	6	6	6	5	6	6	5	6	6	5	4
Others (179)	50	51	52	54	54	54	52	51	50	49	44
HHI export	2621	2523	2452	2441	2700	2542	2361	2387	2102	2445	2629
New Zealand	42	39	37	36	40	38	36	39	33	36	35
Australia	27	29	30	31	32	31	30	28	29	32	36
United Kingdom	9	9	9	8	7	8	9	9	12	10	9
Ireland	5	6	6	5	5	4	4	4	5	4	4
Belgium	2	3	3	3	2	3	2	2	2	1	1
Others (111)	15	15	15	16	14	16	18	19	20	17	15

**Table 3 - Clusters created based on sheep meat competitiveness, production, consumption, and trade**

CL	N	Country
1	49	Armenia, Albania, Angola, Bahamas, Bahrain, Bangladesh, Brazil, Belize, Myanmar, Burundi, Cabo Verde, Congo, Costa Rica, Cuba, Dominica, Dominican Republic, Egypt, Estonia, Finland, Gabon, Ghana, Grenada, Guatemala, Guinea, Honduras, Hungary, Croatia, Israel, Jamaica, Republic of Korea, Latvia, Lithuania, Malawi, Mali, Malta, Czechia, Rwanda, Senegal, Swaziland, Sweden, United Republic of Tanzania, Thailand, Togo, Oman, Uganda, Ukraine, Venezuela (Bolivarian Republic of), Democratic Republic of the Congo, Luxembourg
2	64	Antigua and Barbuda, Austria, Barbados, Bolivia (Plurinational State of), Botswana, Cameroon, Canada, Sri Lanka, Chad, Cyprus, Azerbaijan, Benin, Denmark, Belarus, Ecuador, El Salvador, Fiji, French Polynesia, Georgia, Gambia, Germany, Bosnia and Herzegovina, Greece, Guyana, Indonesia, Italy, Côte d'Ivoire, Kazakhstan, Japan, Jordan, Lebanon, Liberia, Madagascar, Malaysia, Mauritania, Mauritius, Mexico, Morocco, Nepal, Netherlands Antilles (former), New Caledonia, Nicaragua, Niger, Nigeria, Norway, Papua New Guinea, Peru, Philippines, Poland, Portugal, Zimbabwe, Russian Federation, Saint Lucia, Saint Vincent and the Grenadines, Saudi Arabia, Slovenia, Singapore, South Africa, Switzerland, Syrian Arab Republic, Tunisia, United Arab Emirates, Burkina Faso, Belgium
3	20	Argentina, Bulgaria, Chile, Colombia, India, Iran (Islamic Republic of), Ireland, Kyrgyzstan, Kenya, Republic of Moldova, Namibia, Netherlands, Pakistan, Paraguay, Romania, Slovakia, Spain, Turkey, Uruguay, Zambia
4	5	Faroe Islands, Iceland, Kuwait, Mongolia, Qatar
5	2	Brunei Darussalam, Suriname
6	2	Algeria, Libya
7	3	France, United Kingdom, United States of America
8	2	The former Yugoslav Republic of Macedonia, Sudan (former)
9	1	Australia
10	1	New Zealand
11	1	Trinidad and Tobago
12	1	China

**Table 4 - Competitive advantage indices, consumption, and sheep meat market: production, import, and export by cluster**

CL	N	RCA	RPM	RXA	RMA	RTA	NEI	SMP	PC	ISM	ESM
1	49	0.03a	-0.04a	3.31a	2.02a	1.29b <sup>†</sup>	-0.85ab	8,412ab	1.30a	1,021a	21a
2	64	0.12a	-0.29a	1.26a	5.65a	-4.38b	-0.89ab	25,469ab	2.31a	6,208a	619a
3	20	3.65a <sup>†</sup>	0.26a <sup>†</sup>	12.14a	0.74a	11.40b <sup>†</sup>	0.66c <sup>†</sup>	69,397abc	1.93a	1,749a	7,270a
4	5	1.71a <sup>†</sup>	-0.14a	19.15a	2.05a	17.10b <sup>†</sup>	-0.32b	25,669ab	20.3b	4,109a	497a
5	2	0.00a	-0.02a	0.08a	3.45a	-3.37b	-1.00a	22a	0.80a	294a	0a
6	2	0.00a	-0.15a	1.47a	280.86b <sup>†</sup>	-279.39a	-1.00a	117,328bc	5.70a	4,440a	1a
7	3	1.19a <sup>†</sup>	-4.55b	2.53a	3.28a	-0.75b	-0.63ab	167,629c	3.16a	100,317b	33,865b
8	2	12.31b <sup>†</sup>	0.18a <sup>†</sup>	1190.3b <sup>†</sup>	1.92a	1188.38c <sup>†</sup>	0.95c <sup>†</sup>	161,292c	4.35a	35a	3,113a
9	1	21.82 <sup>†</sup>	12.46 <sup>†</sup>	38.31	0.12	38.19 <sup>†</sup>	0.99 <sup>†</sup>	603,972	14.41	755	298,319
10	1	195.38 <sup>†</sup>	19.55 <sup>†</sup>	120.89 <sup>†</sup>	1.10	119.79 <sup>†</sup>	0.99 <sup>†</sup>	514,935	36.58	3,088	362,983
11	1	0.01	-0.05	0.36	2.02	-1.65	-0.99	150	1.3	1,560	4
12	1	0.06	0.00	0.29	1.01	-0.73	-0.71	1,960,400	1.51	105,856	12,597
G	151	2.23	0.01	20.75	7.10	13.65	-0.6	50,981	2.89	6,123	6,426
F		7.793	28.2	414.44	166.47	395.652	75.652	8.755	38.905	57.013	11.101
P		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Means followed by the same letter per column do not differ according to Tukey's test. Clusters with one country were excluded from the MANOVA analysis.

<sup>†</sup> Clusters that had real competitive advantages for the mean of each index.

advantage in producing sheep meat (Faroe Islands, Iceland, Kuwait, Mongolia, Qatar, CL 4). One cluster had a competitive advantage in one index (RTA), but it does not specialize in sheep meat exports, was not positioned in the market, and did not have a comparative advantage for exports nor for production of sheep meat (CL 1). One cluster (CL 7; France, United Kingdom, and the United States of America) had a revealed comparative advantage in sheep meat production (SMP), yet it was the second-largest importer of sheep meat (ISM). The most concentrated cluster (CL 2 with 64 countries), did not have any real competitive advantage, but it does produce sheep meat (SMP) and import sheep meat (ISM) with low exports (ESM). Finally, the majority of the clusters and countries had a total competitive disadvantage in the sheep meat trade, particularly due to the low levels of sheep meat that they exported.

Sheep meat production varied significantly among the clusters of countries, and five of the 12 clusters (119 of 151 countries) produced less than the mean (50,981±178,130). China produced almost two million tons of sheep meat (CL 12), and was the major importer of sheep meat.

As for the sheep meat production annual growth rate (SMPAGR), the clusters were not significantly different ( $P = 0.000$ ); Trinidad and Tobago (CL 11) had an SMPAGR of 88.27, and only Brunei Darussalam, Suriname (CL 5) showed lower levels of sheep meat production than CL 11. The rest of the countries had an SMPAGR between  $-1.10$  and  $8.63$ . The largest average annual per capita consumption growth rate (PCAGR) was for Brunei Darussalam, Suriname (CL 5), followed by Trinidad and Tobago (CL 11), and seven of the twelve clusters had a negative PCAGR (Table 5). In this case, clusters were significantly different ( $P = 0.000$ ) due to high values of CL 5. The PCAGR results show that, in general, the global population is not consuming sheep meat, with a global 2.25 per capita consumption growth rate.

With regard to per capita consumption, the results show that the two dominant countries CL 10 (New Zealand) and CL 9 (Australia), as well as CL 4 (Faroe Islands, Iceland, Kuwait, Mongolia, Qatar), had the largest per capita consumption values (Figure 1).

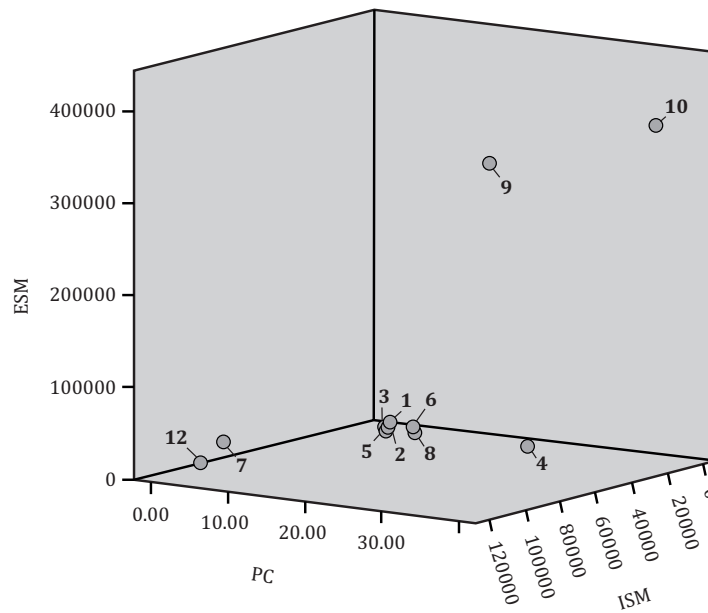
**Table 5** - Sheep meat production annual growth rate (SMPAGR) and average annual per capita consumption growth rate (PCAGR) for meat production by cluster

CL	SMPAGR	PCAGR
1	8.63a	7.47a
2	0.13a	-1.20a
3	-0.53a	-1.30a
4	2.04a	-1.28a
5	0.07a	38.51b
6	3.87a	2.10a
7	-1.10a	-2.20a
8	0.73a	-0.92a
9	1.41	-4.88
10	-0.97	-2.60
11	88.27	15.81
12	1.92	2.42
Global	3.49	2.25
F	16.219	34.686
P	0.000	0.000

Clusters with one country were excluded from the MANOVA analysis.

Means followed by the same letter in a column do not differ according to Tukey's test.





**Figure 1** - Scatterplot between sheep meat export (ESM), import (ISM), and per capita consumption (PC) for the clusters obtained.

## Discussion

At the international trade level, the more concentrated the industry, the less competitive it is (Kim and Marion, 1997), and our findings agree. For the international sheep meat trade, two countries were responsible for 68.15% of the global sheep meat exports making it a highly concentrated market; therefore, the market structure can be considered as a duopoly (Brezina et al., 2016). Under this structure, only 24 of 151 countries had real competitive advantages, so most of the countries that participated in sheep meat trade and production were uncompetitive.

On the contrary, the HHI for market structure allows us to point out the following: first, mean values regarding the global market for sheep meat production and sheep imports were low (766 and 663, respectively) and, therefore, should be considered as unconcentrated markets; for example, when the market has a single seller (monopoly), the HHI value would be 10,000 (Greco, 2000); and second, the structure of the global market for sheep imports became more concentrated due to increasing demand from China in recent years. On the contrary, the export market structure was highly concentrated under a duopoly category, being dominated by Australia and New Zealand. Both of them had the largest per capita consumption.

The philosophical approach to market-oriented and social value-oriented systems presented by Ørskov (2011) may explain the findings regarding the sheep meat global market. Market-oriented systems look for profit maximization and productivity, while social value-oriented systems aim for risk minimization and family support, where risk minimization is more important than profit maximization. In countries with social value-oriented systems, sheep breeding for meat production is influenced by customs and the family to maintain traditional routines in rural environments (Viana and Waquil, 2013), in particular, those least-developed countries and regions that rely heavily on small-scale grazing systems for local consumption (Dell'Angelo et al., 2017), such as Central American countries and African regions. In some cases, sheep meat is offered to consumers in the markets without official inspection, allowing for negative experiences that do not stimulate consumption, e.g., Brazil (Firetti et al., 2018).

The lack of competitiveness is also aggravated due to the absence of domestic competition (Bramati et al., 2015), trade barriers (Bucevska and Hadzi Misheva, 2017), and domestic policies (Yi et al., 2018). Competitiveness in export performance in the traditional Ricardian approach



establishes that a nation will specialize in industries in which they have comparative cost advantages, especially due to inherited natural resources and reduced labor costs. Still, other factors such as technology and institutions may also produce a positive effect (Carlin et al., 2001). The top two countries (New Zealand and Australia) not only benefit from natural resources, but have also developed an institutional framework (Meat & Livestock Australia is an Australian producer-owned company that offers research, development, and marketing services; Beef + Lamb New Zealand Ltd. is a farmer-owned industry organization representing New Zealand's sheep and beef farmers), physical structure, and knowledge and skills that give the region competitive advantages over the other countries. Even more, it has been observed earlier that the structure of domestic demand has a deterministic role in the exporting characteristics of goods where a strong local demand positively affects global markets (Kim and Marion, 1997); this was the case for New Zealand and Australia.

Local demand from the Muslim population has been important for the development of sheep meat production and international trade participation. This is not only true for Muslim countries (CL 4, CL 5, CL 6), but also for some European countries that have a significant Muslim population such as France and the United Kingdom (CL 7). Another consideration is that demand for sheep meat is also related to the purchasing power of the population; thus, mainly countries with substantial economic growth are able to increase the demand for this kind of meat, which depends on seasonal and religious celebration behavior (Viana et al., 2015). The CL 3 (Argentina, Bulgaria, Chile, Colombia, India, Islamic Republic of Iran, Ireland, Kyrgyzstan, Kenya, Republic of Moldova, Namibia, Netherlands, Pakistan, Paraguay, Romania, Slovakia, Spain, Turkey, Uruguay, Zambia) is made up of countries that have real competitive advantages but do not have large sheep meat production volumes compared with other clusters (CL 6-CL 10). One reason is that some countries used to specialize in sheep for wool production, e.g., Uruguay, and as wool markets have collapsed in recent years, they have reoriented themselves towards meat production (Branscheid, 2010). Furthermore, some countries specialize in producing dairy products made with sheep milk, such as PDO traditional cheese types, e.g., Spain's Manchego (Pulina et al., 2018). Still, this type of dairy product remains a small market compared with cow milk dairy products.

Returning to the particular case of New Zealand, since the end of the last century, the country has established some liberalization reforms in the agricultural sector that have negatively impacted sheep meat production (Montossi et al., 2013). Nevertheless, this country has been able to retain its position in the global scene and has become one of the most competitive countries in agricultural trade (Jambor and Babu, 2016). It can be observed that Australia was growing in terms of market share for sheep meat exports, but as Australia also trades with other meats, it was not as specialized as New Zealand. Specialization is a factor in economic growth and competitiveness (Dalum et al., 1999), which explains why New Zealand has prevailed as the most competitive country for sheep meat.

## Conclusions

In terms of the structure, it can be concluded that production and imports of sheep meat are unconcentrated, as there is no country dominating the market for those indices; in contrast, the export market is highly concentrated with a duopolistic structure. However, in what concerns the competitiveness conclusion, only New Zealand can be defined as competitive, specialized, and volume dominant.

The implications of this study for farmers and policymakers is that both should focus in developing and straining the internal market as competing in the export market results challenging. Still, two sheep meat production patterns can be observed from this study: countries with local production for local markets generally comprising social value-oriented production systems and trade-oriented production for global markets comprising commercial production systems. Therefore, when policymakers consider supporting sheep breeding programs, they ought to have a holistic vision that considers understanding the global sheep meat market. Within this context, sheep breeding in lesser-developed countries and regions that rely heavily on small-scale grazing and social value-oriented systems will find it difficult to compete in the global trade sheep market, not only leading to the perpetuation of the current undeveloped small sheep farmers, but also to a more concentrated global sheep meat market.

## Conflict of Interest

The authors declare no conflict of interest.

## Author Contributions

Conceptualization: K.A. Figueroa-Rodríguez. Formal analysis: B. Figueroa-Sandoval and K.A. Figueroa-Rodríguez. Investigation: A. Ramírez-López. Methodology: K.A. Figueroa-Rodríguez. Writing-original draft: K.A. Figueroa-Rodríguez. Writing-review & editing: B. Ramírez-Valverde.

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