World Rabbit Sci. 2022, 30: 69-82
doi:10.4995/wrs.2022.13390
WRSA, UPV, 2003

RABBIT MEAT TRADE OF MAJOR COUNTRIES: REGIONAL PATTERN AND DRIVING FORCES

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Abstract: In in the last 60 or so years, the global rabbit industry has been growing steadily. This paper studies the global rabbit meat trade by focusing on trade growth and regional pattern. First, rabbit meat production and regional structure are introduced, as the basis of trade. Then, the global rabbit meat trade is studied in detail, including trade growth, regional structural changes, comparative advantages and competitiveness of major countries. Finally, a gravity model is built to test major factors affecting the rabbit meat trade and explore the driving forces behind the trade. The data come from different channels, including the Food and Agriculture Organization of the United Nations, World Bank, the World Trade Organization and related government statistics. The results show that: (1) Over the past 60 yr, the global rabbit industry has achieved great progress. In the first half of the period, rabbit meat was mainly produced in Europe; then, rabbit meat production in Asia increased steadily and rapidly in the second half period, while European production decreased continuously. (2) The rabbit meat trade had been increasing for about 20 yr from 1961 to 1979, after which it fluctuated for another 20 yr. However, since 2001 it has been stable around an average level of 37 thousand tonnes, with only minor fluctuation. The trade pattern is currently from Asia (mainly China) and South America (mainly Argentina) to European countries. In 2018, the top 5 export destinations were Germany, Belgium, Italy, Portugal and France (3). Hungary and Argentina have been two strong competitors in the last two decades, while Spain and Belgium are two new and promising countries in the rabbit meat trade. Now China no longer has comparative advantages in the rabbit meat trade (4). The gravity model results show that rabbit meat trade is mainly driven by demand. Countries with a high Gross Domestic Product tend to increase their imports more, but decrease their exports. Countries with higher populations export more rabbit meat but import less. Common language and contiguity of two countries have significant impacts on rabbit meat trade. Based on the above results, some suggestions and policy implications are provided. Rabbit farmers or processing companies should pay more attention to domestic consumers or neighbouring countries to survey potential markets; traders should explore more markets in order to reduce the degree of trade concentration and lower risks. Governments should popularise the nutritional knowledge of rabbit meat to encourage people (especially young people) to consume more healthy rabbit meat instead of pork, with a view to reducing obesity or other heart diseases, etc.

Key Words: rabbit meat, meat production, meat trade, comparative advantages.

INTRODUCTION

In the last several decades, the rabbit industry has contributed much to rural economic growth and social development in many countries. This is attributed to its good characteristics, such as flexible investment, easy starting and management, saving grain and land resources, producing high quality meat and creating jobs for rural

Correspondence: L.Wu, *wulp@cau.edu.cn*. Received *April 2020* - Accepted *October 2021*.
https://doi.org/10.4995/wrs.2022.13390

This work has been presented as guest talk at the 12th World Rabbit Congress (Nov 3rd-5th, 2021, Nantes, France).

Cite as: Wu L. 2022. Rabbit meat trade of major countries: regional pattern and driving forces. *World Rabbit Sci., 30: 69-82. https://doi.org/10.4995/wrs.2022.13390*

people, especially women or elderly people. In several developing countries, rabbit rearing has helped many poor people out of poverty. From the global perspective, rabbit meat output has kept steadily increasing for almost 60 yr. According to statistics from the Food and Agriculture Organization of the United Nations (UN FAO), from 1961 to 1985 the world supply of rabbit meat was mainly produced in Europe, which had accounted for more than 80% for around 25 yr. However, in the last 30 yr the rabbit industry in Asia has increased rapidly and Asia has become a major producing region. In 2018, global rabbit meat output reached 1.39 million tonnes, of which the share of European countries only accounted for 19.43%, while Asian countries were predominant with a 72.71% share.

It is significant that the rabbit meat producing area moved from Europe to Asia, but was this regional production change accompanied by restructuring of the rabbit meat trade? How did the trade pattern evolve over the past several decades? Does this mean that rabbit meat consumption also moved from Europe to Asia? There are few research works on the global rabbit meat trade. Smutka and Rosochatecka (2010) studied the development of the rabbit meat trade and found that rabbit meat production and trade had been constantly increasing. The research by Niedzwiadek (1994) showed that the major rabbit meat producing companies were Italy, France, China and Spain. The consumption area included Italy, France, Spain, Belgium, Portugal and Malta, and per capita consumption ranged from 2.0 to 5.3 kg. Some research focused on a specific country or region to study its trade: Szendrő (2015) and Szendrő and Bleyer (1999) studied the Hungary case of production and trade: Popescu-Miclosanu and Stanciu (2013) analysed the evolution of world and Romanian meat rabbit production and trade balance.

Compared to trade, there are more research works on rabbit meat production and consumption. The study on rabbit meat production and consumption by Cullere and Zotte (2018) showed that rabbit had many good characteristics and could be considered an ideal meat producing animal, but the consumption worldwide was not prevalent. McNitt *et al.* (2013) summarised the rabbit production in major areas of the world and discussed the future of world rabbit production and rabbit research. In the early years before 1990s, related research mainly focused on meat supply in order to meet greater demand (Parkin 1972; Roberts 1980; Owen 1981). Recently, more research works on production have paid attention to technology and efficiency. Trocino *et al.* (2019) evaluated production, research funds and scientific activity relating to rabbits in Italy, Europe and worldwide over the last 20 yr. Khan *et al.* (2017) examined the production performance of indigenous rabbits under traditional and intensive systems in Pakistan. Lukefahr *et al.* (2004) reviewed the meat rabbit production in North America. From the perspective of rabbit meat consumption, some research focused on specific groups of people, including children and university students (González-Redondo *et al.,* 2010; Escribá-Pérez *et al.* 2019), but most research works concentrated on one country, including Italy, France, Hungary, Spain, the USA and Mexico, among others (Chalah and Hajj 1996; Beal *et al.* 2004; Olivares *et al.* 2005; Bodnar and Horvath 2008; Dairo *et al.* 2012; Kowalska 2015; Petracci *et al.* 2018; Sanah *et al.* 2020). Sugiyama *et al.* (2017) studied meat consumption in Mexico from the standpoint of varied ecological and social contexts.

There is a large body of multidisciplinary agricultural studies on rabbit that cover rabbit meat quality, rabbit behaviour and welfare, etc. Many researchers have studied the impact of different factors on rabbit meat quality, including cage and pen housing (Combes *et al.* 2010; Matics *et al.* 2019), limited feed intake (Gidenne *et al.* 2012; Chodova *et al.* 2019) and different feed additives (Dabbou *et al.* 2017; Wahyuni *et al.* 2018; Minardi *et al.*, 2020). Cavani *et al.* (2009) reviewed the advances in research on poultry and rabbit meat quality. Lehmann (1991) examined the social behaviour in young domestic rabbits under semi-natural conditions. Verga *et al.* (2009) analysed the welfare aspects in rabbit rearing and transport, Nielsen *et al.* (2020) focused on health and welfare of rabbits which were farmed in different production systems. There are also many works on rabbit industry development and the competitiveness of major countries (Foster and Telford 1996; Luo and Wu 2019; Wu and Qin 2019).

However, there are still considerable gaps in rabbit meat trade research. The aim of this work is to conduct the study on the global trade growth of rabbit meat over the past several decades, and this paper will focus on changes in trade volume, regional structure and its evolution, and the driving forces.

MATERIALS AND METHODS

Analytical framework and data

Theoretically, trade is determined by a country's resource endowment and comparative advantages. Resource endowment refers to the amount of land, labour, capital and entrepreneurship that a country possesses and can exploit for producing. Countries with a large endowment of resources tend to be more prosperous and more competent than those with a small endowment. The law of comparative advantage describes how, under free trade, a country will produce and export more of and consume less of a good that they can produce at low cost and price. This is due to the richness of resources.

Based on free trade and comparative advantage theory, the import and export mechanism is depicted in the chart below (Figure 1). Resources endowment determines the comparative advantages. However, comparative advantage is only potential for export, and only through effective marketing to attract more buyers can it become competitiveness. From the supply side (the upper half of Figure 1), price, quality and convenience are the fundamentals of competitiveness, and they are also the permanent driving forces for export.

As for imports (lower half of Figure 1), population and income are the bases of demand. However, they are also the potentials for purchasing or importing. Only by cultivating consumer preferences can potential purchasing power become real demand. Therefore, population, income and preference are fundamental driving forces of imports.

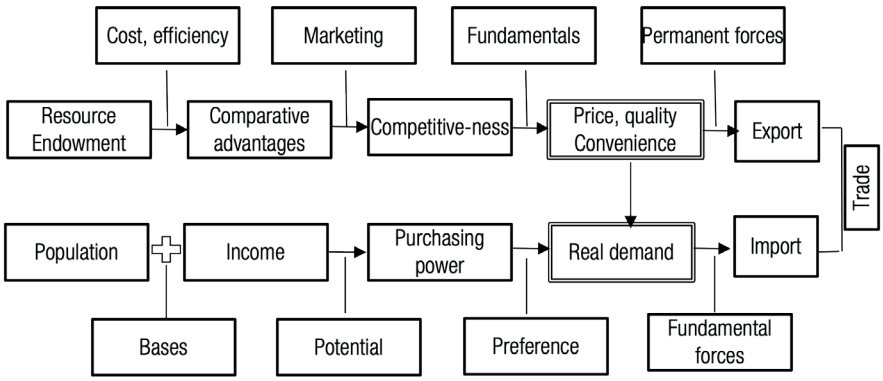

Figure 1: Trade and its determinants.

Based on the above mechanism, the key factors will be selected to examine the trade characteristics of major countries. From the production and export side, *cost*, *price* and *comparative advantage (RCA)* will be addressed. From the demand and imports side, *population*, *income* and *preference change* in major countries will also be considered. Finally, a *gravity model* will be constructed to test the impacts of these factors on rabbit meat trade.

Revealed comparative advantage index (RCA)

RCA can measure and compare the advantages of different countries in global trade. It is the proportion of the export value of a good in one country's total commodity exports divided by the share of the world's total export value of the same good in the world's total export value of all goods. The RCA is calculated by Equation (1):

$$RCA_{iC}=(X_{iC}/X_{it})/(X_{wC}/X_{wt}) \quad (1)$$

where RCA_{iC} represents the revealed comparative advantage index of good *j* in country *i*, X_{iC} is the export value of good *C* in country *i*, X_{it} is the total export value of all goods in country *i*, X_{wC} is the total export value of good *C* in the world, X_{wt} is the total export value of all goods in the world. If $RCA_{iC}>1$, it means that good *C* in country *i* has *revealed comparative advantage*, otherwise it does not.

Gravity model

The gravity model of international trade is a model which, in its traditional form, predicts bilateral trade flows based on the economic sizes and distance between two countries, which was first introduced in economics by Walter Isard (1954). The general form of the Gravity model is given by Equation (2):

$$T_{ij}=a_0 Y_i^{a1} Y_j^{a2} D_{ij}^{a3} A_{ij}^{a4} \quad (2)$$

where T_{ij} is the trade between country *i* and *j*, Y_i and Y_j are respectively GDP of country *i* and *j*, D_{ij} is the distance between two countries, and A_{ij} denotes trade policy and other factors.

Trade includes export and import, therefore export and import models are specified as follows:

$$\ln EXij=a_0+a_1\ln GDPi+a_2\ln GDPj+a_3\ln POP_i+a_4\ln POP_j+a_5\ln DIS_{ij}+a_6 WTOij+a_7 BORij+a_8 Languij+u_{ij} \quad (3)$$

$$\ln IMij=b_0+b_1\ln GDPi+b_2\ln GDPj+b_3\ln POP_i+b_4\ln POP_j+b_5\ln DIS_{ij}+b_6 WTOij+b_7 BORij+a_8 Languij+\sigma_{ij} \quad (4)$$

EXij and *IMij* respectively represent export and import from country *i* to country *j*. *GDP and POP* are Gross Domestic Product and population. DIS_{ij} stands for the distance between two countries. *WTOij* refers to the membership in General Agreement on Tariffs and Trade (GATT)/World Trade Ognanization (WTO); if one country is a member of GATT/WTO, it will be 1, otherwise 0. *BORij* denotes contiguity of two countries; if two countries are neighbours, it will be 1, otherwise 0. *Languij* represents the language; if two countries have a common official or primary language, it will be 1, otherwise 0. $a_0 \sim a_8$ *and* $b_0 \sim b_8$ *are* coefficients to be estimated. u_{ij} and σ_{ij} are disturbance.

When running the model, in order to capture the general effects of all these factors on both export and import, the general trade model will also be run, so there will be three models as follows: (1) model 1, *export model*, which is specified as Equation 3, and the top 6 exporting countries will be chosen with their partners as samples; the total sample is 2259; (2) model 2, *import model,* which is specified as Equation 4, and the top 6 major importing countries and their partners are selected as samples; the total number is 1339; (3) model 3, *trade model* (both export and import together), designed to capture the general impacts of major factors on rabbit meat trade. The data in all these models cover the years from 1990 to 2018.

Data used in this paper comes from different channels: rabbit meat production data is from the FAO statistics, the trade and WTO membership data are collected from the World Trade Organisation and the data on distance between countries is from CEPII Database (Centre d'Etudes Prospectives et d'Informations Internationales). GDP and Population are from the World Bank, and other data from related country government statistics.

RESULTS AND DISCUSSION

Global rabbit meat production and regional structure

Rabbit industry is pro-poor and environment-friendly, and the rabbit is a small animal that needs less feed, with a high feed conversion ratio. Generally, feed costs could be reduced through the use of homegrown or less expensive feedstuffs; labour could be shared among family members and less expensive housing and equipment would be needed (Lukefahr, 1999). During the early period of economic development, many countries give rabbit industry much higher priority in policy making. From the evolution of global rabbit production (Table 1), it can be seen that: (1) The rabbit industry has undergone fast growth since 1961. Meat output increased from 397.06 thousand tonnes (1961) to 1394 million tonnes (2018), with an annual growth rate of 2.23% (Figure 2); (2) The whole period of rabbit meat production from 1961 to 2018 can be divided into three periods, *fast increase* (1961-1988), *transition period* (1983-1999), and *fast and steady increase* (1991-). The growth rates during these three periods were 2.79, 0.43 and 4.77%, respectively; (3) the meat output growth in the first period mainly took place in Europe, with an average share of 85.99%. Asian countries only accounted for 7.87%. After adjustment in the transition period from 1983 to 1999, the major producing area moved from Europe to Asia. Since 1990, rabbit meat output in Europe has been in ongoing decline, but that of Asian countries has continuously increased. The share of European rabbit meat decreased from 76.26% (1990) to 19.43% (2018), but during the same period, the share of Asian rabbit meat output increased from 12.61 to 72.72%. In 2018, the rabbit meat outputs in Asian and European countries were 1.01 million tonnes and 0.27 million tonnes, respectively.

Table 1: Global rabbit meat production in major years (1961-2018).

		Europe		Asia		Africa		Americas	
Year	World	Quantity	Share	Quantity	Share	Quantity	Share	Quantity	Share
1961	397062	359413	90.52%	15660	3.94%	11734	2.96%	10255	2.58%
1966	421680	372678	88.38%	24270	5.76%	13614	3.23%	11119	2.64%
1971	537663	470696	87.54%	40835	7.59%	15091	2.81%	11040	2.05%
1976	686787	601035	87.51%	54682	7.96%	16364	2.38%	14706	2.14%
1981	723111	613031	84.78%	60578	8.38%	31446	4.35%	18056	2.50%
1986	776978	622438	80.11%	79627	10.25%	57481	7.40%	17433	2.24%
1991	630826	428733	67.96%	110691	17.55%	68702	10.89%	22700	3.60%
1996	809576	390833	48.28%	323472	39.96%	74275	9.17%	20996	2.59%
2001	961707	363605	37.81%	501967	52.20%	75007	7.80%	21128	2.20%
2006	1055021	307471	29.14%	652084	61.81%	76701	7.27%	18766	1.78%
2011	1292598	306282	23.70%	885222	68.48%	83440	6.46%	17653	1.37%
2016	1351721	294235	21.77%	947968	70.13%	92238	6.82%	17279	1.28%
2017	1400149	280449	20.03%	1010095	72.14%	93037	6.64%	16569	1.18%
2018	1393899	270877	19.43%	1013503	72.71%	92720	6.65%	16799	1.21%

Data source: FAO Statistics, http://www.fao.org/faostat/en/. Quantity in tonnes.

From the perspective of major producing countries, during the 1960s and 70s France was the main producer, while Italy ranked second. In the 60s, two countries produced more than 58.68% of global rabbit meat, and in the 70s they were still producing more than 45.93% global rabbit meat. In 1979, Italy became the biggest producer, with a share of 22.23% and first surpassed that of France (20.93%). This trend continued till 1990. Since 1991, Asian countries have taken the stage, especially China. In 1991, China became the largest producer, and its share increased from 28.04% (1992) to 62.01% (2018).

In 2018, the top 5 major producing countries were China, the Democratic People's Republic of Korea, Egypt, Spain and France (Figure 3). In total, they produced 1.172 million tonnes of rabbit meat, accounting for 84.05% of the global total. The share of the top ten countries reached 94.45%. So, the concentration rate of production is very high.

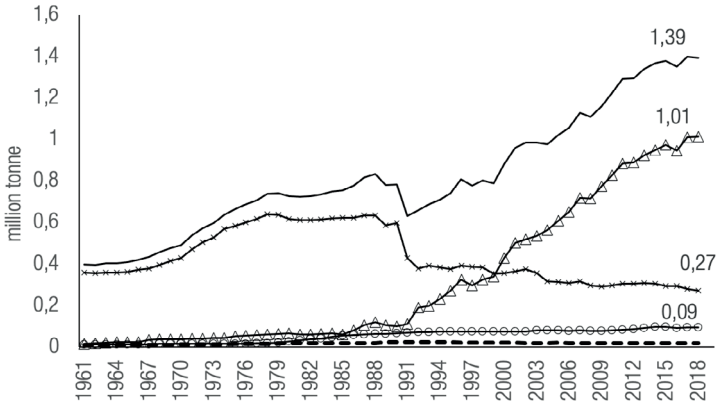

Figure 2: Global rabbit meat outputs across continents (1961-2018). ———: World; —o—: Africa; ------: Americas; —△—: Asia; —×—: Europe. Data source: FAO Statistics, http://www.fao.org/faostat/en/

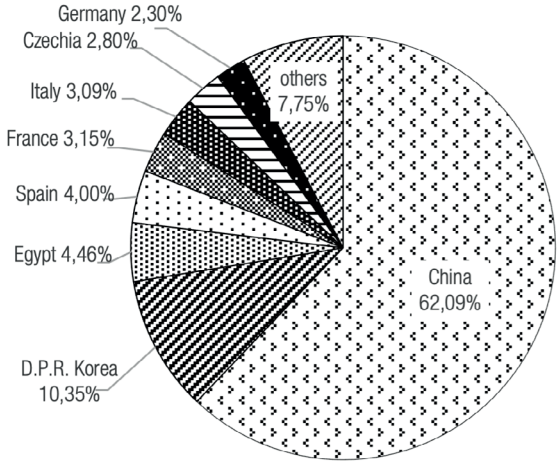

Figure 3: Rabbit meat output and shares of major producing countries in 2018 (unit: tonnes). Note: Global rabbit meat output in 2018 was 1.394 million tonnes. Data source: FAO statistics, http://www.fao.org/faostat/en/.

Rabbit meat trade and structural changes

Globally, total exports must be equal to total imports. Therefore, from a global standpoint exports will be studied in detail, but for specific country, both exports and imports will be considered. Figure 4 represents global rabbit meat exports across continents from 1961 to 201. It can be seen that rabbit meat exports had been increasing for about 20 yr before 1980, but after 1980 exports were fluctuating for another 20 yr around 58.40 thousand tonnes. After 2001, global rabbit exports became stable at the level of around 36.97 thousand tonnes, with little fluctuation. In 2018 it was 33.63 thousand tonnes. However, Europe has been the main destination for rabbit meat exports since 1961, with an average share of 95.30% of total exports. It is clear that before 1985 rabbit meat trade mainly took place between Asia and Europe, but since 1985 rabbit meat has been traded mainly within European countries, and with a certain supplement from Asia (mainly from China).

As regards countries, for a long time China, France, and Hungary have been major exporters. Since 2001, export in Spain have increased rapidly. The importing countries are Germany, France, and Italy, among others. Figure 5 shows

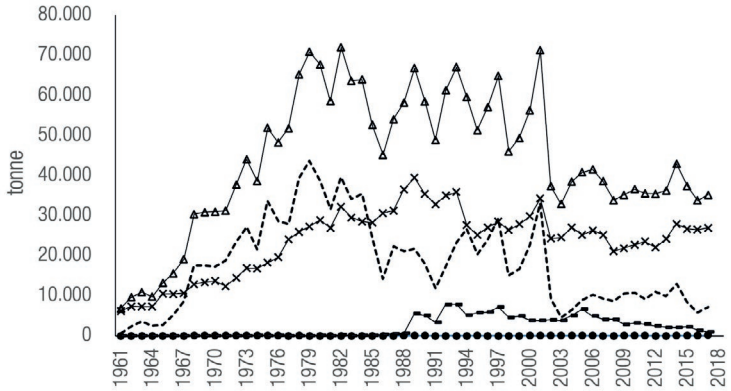

Figure 4: Global rabbit meat export across continents (1961-2018). —●—: Africa; —×—: Europe; ------: Asia; —■—: Americas; —△—: World. Data source: FAO Statistics, http://www.fao.org/faostat/en/.

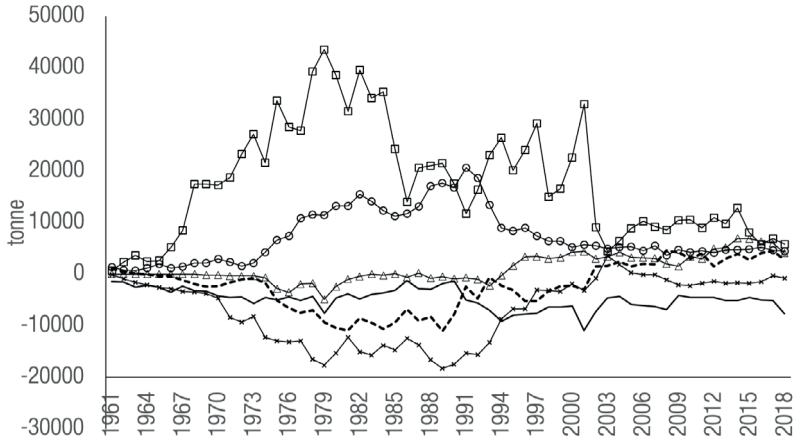

Figure 5: Net exports of rabbit meat from major countries (1961-2018). —□—: China; —×—: Italy; —○—: Hungary; ------: France; ———: Germany; —△—: Spain. Data source: FAO Statistics, http://www.fao.org/faostat/en/.

the net exports (net export is equal to export minus import. It is one country's contribution to the global market; if net export is greater than 0, it means this country exports more than it imports, and vice versa) of major countries since 1961. It can be observed that during the entire 60s-70s period, rabbit meat was mainly exported from China and Hungary to Italy, France and Germany. However, from the start of the 1980s, the rabbit meat exported from China went into decline, and from the early 1990s exports from Hungary also declined. Correspondingly, the rabbit meat imports of France and Italy also decreased. After 2001, both exports and imports were at a low level and remained stable for about ten years. This shows that the self-sufficiency rate of major countries is increasing.

Table 2: Top 10 countries for rabbit meat exports and imports in 2018 Units: tonnes, million USD

	Export					Import				
	Country	Quantity	share	Value	share	Country	Quantity	share	Value	share
1	China	5964	17.73%	28.61	15.91%	1 Germany	8105	24.70%	48.77	27.87%
2	Spain	5639	16.77%	25.31	14.07%	2 Belgium	5276	16.08%	30.89	17.66%
3	Belgium	5035	14.97%	30.56	17.00%	3 Italy	2915	8.88%	13.08	7.48%
4	France	4786	14.23%	27.06	15.05%	4 Portugal	2881	8.78%	11.47	6.55%
5	Hungary	4406	13.10%	28.13	15.64%	5 France	1974	6.01%	11.03	6.30%
Top 5 sum		25830	76.81%	139.68	77.67%	Top 5 sum	21151	64.45%	115.24	65.87%
6	Italy	2135	6.35%	5.94	3.30%	6 Spain	1579	4.81%	5.46	3.12%
7	Netherlands	1003	2.98%	8.08	4.49%	7 Czech Rep.	1312	4.00%	6.57	3.75%
8	Argentina	924	2.75%	7.09	3.94%	8 United States	1279	3.90%	5.37	3.07%
9	Portugal	704	2.09%	3.41	1.90%	9 Switzerland	929	2.83%	7.54	4.31%
10	United Arab Emirates	517	1.54%	1.51	0.84%	10 Poland	801	2.44%	4.79	2.74%
Top 10 sum		31114	92.52%	165.71	92.15%	Top 10 sum	27051	82.43%	144.98	82.86%
Global total		33629	100%	179.83	100%	Global total	32817	100%	174.97	100%

Data source: WITS database, http://wits.worldbank.org/WITS/.

Note: Theoretically, global export is equal to global import. However, there is a difference due to statistical and other errors. The error rates of trade quantity and value are 2.415% and 2.701%, respectively; the statistics are still reliable.

In 2018, there were 43 countries exporting rabbit meat. The top 10 exporting and importing countries are listed in Table 2. The top 5 are China, Spain, Belgium France, and Hungary; they exported 25830 tonnes of rabbit meat, accounting for 76.81% of global total export. The top 10 countries exported 31114 tonnes, representing 92.52%. Except for China, Argentina and the United Arab Emirates, the others are all European countries. Unlike exports, rabbit meat importation is more scattered. In 2018, a total of 69 countries imported rabbit meat. The top 5 were Germany, Belgium, Italy, Portugal and France; they imported 21151 tonnes, accounting for 64.65% of global total import. The share of the top 10 countries is 82.43%. Except for the United States, the other top 9 importers are all European countries. Europe is still the traditional area of rabbit meat consumption.

There is an interesting phenomenon insofar as some countries both import and export much rabbit meat, which is also known as intra-industry trade (*Intra-industry trade* refers to the exchange of similar or same products belonging to the same industry, which also means the same types of goods or services are both imported and exported. This phenomenon is present in many manufacturing industries). From Table 2, it can be seen that this intra-industry trade mainly takes place in Belgium, France and Italy. In order to understand more details of these major trading countries,

Table 3: Intra-industry trade of Belgium, France and Italy in 2018.

Belgium			France			Italy		
28 Export partners			53 Export partners			31 Export partners		
Top 10 Destination	Quantity (tonne)	Share (%)	Top 10 Destination	Quantity (tonne)	Share (%)	Top 10 Destination	Quantity (tonne)	Share (%)
France	1601	31.80	Italy	1147	23.97	China	644	30.15
Netherlands	1396	27.72	Germany	1020	21.31	Germany	363	16.99
Germany	1142	22.68	Belgium	748	15.63	Hungary	313	14.64
China	384	7.62	Spain	478	9.99	Malta	269	12.58
Luxembourg	185	3.67	UK	441	9.21	Vietnam	126	5.90
United Kingdom	117	2.32	Luxembourg	152	3.17	Poland	107	5.02
Italy	55	1.09	Switzerland	131	2.75	Greece	93	4.34
Hong Kong, China	51	1.02	United States	121	2.52	Hong Kong, China	76	3.54
Spain	31	0.61	Netherlands	110	2.31	Switzerland	29	1.35
Switzerland	22	0.44	Malta	97	2.02	France	27	1.26
Sum of top 5	4708	93.49	Sum of top 5	3834	80.11	Sum of top 5	1714	80.26
Sum of top 10	4983	98.96	Sum of top 10	4445	92.88	Sum of top 10	2045	95.77
World	5035	100	World	4786	100	World	2135	100

Belgium			France			Italy		
15 Import partners			16 Import partners			12 Import partners		
Import Origins	Quantity (tonne)	Share (%)	Import Origins	Quantity (tonne)	Share (%)	Import Origins	Quantity (tonne)	Share (%)
China	2296	43.51%	China	775	39.25%	France	1345	46.14%
France	799	15.14%	Belgium	458	23.20%	Spain	713	24.45%
Argentina	724	13.72%	Spain	338	17.13%	Poland	328	11.26%
Spain	505	9.57%	Argentina	107	5.40%	Hungary	194	6.67%
Netherlands	317	6.00%	UK	78	3.95%	Argentina	113	3.89%
Germany	189	3.58%	Hungary	66	3.33%	UK	76	2.61%
UK	159	3.01%	Vietnam	49	2.49%	Netherlands	53	1.82%
Uruguay	111	2.10%	Italy	36	1.82%	Germany	41	1.39%
Chile	70	1.32%	Netherlands	15	0.77%	Slovenia	25	0.85%
Poland	50	0.96%	Poland	15	0.76%	Belgium	25	0.84%
Sum of top 5	4640	87.95%	Sum of top 5	1755	88.93%	Sum of top 5	2694	92.40%
Sum of top 10	5219	98.91%	Sum of top 10	1936	98.08%	Sum of top 10	2913	99.91%
World	5276	100.00%	World	1974	100.00%	World	2915	100.00%

Data source: WITS database, http://wits.worldbank.org/WITS/.

three countries, Belgium, France and Italy, are selected and their regional structure is studied (Table 3). In 2018, Belgium exported its rabbit meat to 28 countries, but mainly focused on the top 5, which accounts for 93.49%. France even exported to 53 countries or regions, but the top 5 and top 10 countries accounted for 80.11% and 92.88%, respectively. Italy exported to 31 countries, and 80.26% was sold to the top 5 countries and 95.77% to the top 10 countries. Compared with exports, the imports of these three countries more concentrated on fewer countries. Belgium imported from 15 countries, while France and Italy imported from 16 and 12 countries, respectively.

Theoretically, intra-industry trade may be due to the distance between countries. The impacts of distance and whether two countries border each other will be tested later in the gravity model section. There are also some other explanations, such as differentiation of products. Rabbit meat is actually not homogeneous, and includes fresh, frozen and different types of processing, and different parts (e.g. head, leg) etc. Some experts also explain the issue from the technology perspective.

The above analysis shows that the degrees of trade concentration are much lower in France and Italy (trade concentration degree, or concentration ratio, is usually applied to show the extent of trade control of the largest countries in global trade and to illustrate the degree to which the global market is oligopolistic. For one country, a low concentration ratio means more trade partners and lower risks). Low concentration degree means more trade partners and low risk. This explains why they can maintain a long-term trade position in the global rabbit meat market without much fluctuation.

Trade can be pushed by production, while it can also be driven by consumption. In the rest of this section, total rabbit meat consumption in major countries will be studied. First, total consumption in each country is calculated by the following method:

Total consumption = total output + import - export

Based on FAO statistics, the total and per capita consumption in major countries were calculated, as illustrated in Table 4. There are two countries that should be paid more attention, namely France and China. In France, both total consumption and per capita consumption of rabbit meat show a decreasing trend since 1961. In contrast, both total

Table 4: Rabbit meat consumption in major countries (1961-2018). Unit: thousand tonnes, kg.

	France		Italy		Germany		Spain		China	
Year	Total	Per capita	Total	Per capita	Total	Per capita	Total	Per capita	Total	Per capita
1961	188.97	4.084	49.03	0.980	17.78	0.241	20.56	0.669	9.86	0.015
1966	185.35	3.765	71.24	1.368	28.81	0.375	17.70	0.545	14.31	0.019
1971	181.67	3.551	100.03	1.856	48.24	0.612	25.85	0.754	18.73	0.022
1976	178.62	3.372	139.35	2.509	46.74	0.593	90.96	2.508	19.46	0.021
1981	154.12	2.848	191.31	3.386	39.88	0.511	76.85	2.024	23.96	0.024
1986	138.07	2.486	196.89	3.455	34.76	0.447	78.27	2.014	60.00	0.055
1991	94.76	1.665	49.42	0.866	40.46	0.509	78.69	2.002	96.24	0.081
1996	87.27	1.504	45.77	0.802	46.67	0.574	118.62	2.972	281.90	0.225
2001	76.19	1.283	46.04	0.810	47.24	0.580	107.13	2.593	373.04	0.287
2006	64.48	1.048	42.27	0.722	38.08	0.467	69.17	1.546	534.55	0.399
2011	52.30	0.827	53.34	0.895	39.68	0.491	61.17	1.299	722.01	0.525
2012	51.45	0.809	54.65	0.913	40.78	0.504	59.63	1.267	724.07	0.523
2013	49.18	0.770	56.89	0.946	41.49	0.511	58.16	1.239	761.15	0.547
2014	49.46	0.770	54.99	0.910	39.35	0.483	56.88	1.216	776.23	0.555
2015	49.30	0.765	56.83	0.938	38.30	0.468	47.21	1.011	802.74	0.571
2016	44.59	0.690	57.99	0.956	38.05	0.463	53.24	1.142	782.91	0.554
2017	41.20	0.635	49.42	0.814	37.63	0.455	51.31	1.100	845.44	0.595
2018*	41.07	0.632	43.89	0.724	39.78	0.479	51.76	1.109	859.60	0.602

Data source: FAO Statistics, http://www.fao.org/faostat/en/. Total consumption is calculated by output + import - export. *2018 data is from WITS database.

and per capita consumption in China have tended to increase continuously since 1961. The two countries show significant substitution. The per capita consumption in France decreased from 4.084 kg (1961) to 0.632 kg (2018). However, in China, during the same period it increased from 0.015 to 0.602 kg.

In a similar way to China, Spain also shows the increasing trend, but with slow growth and slight fluctuation. However, in 2018 per capita consumption reached 1.109 kg, which was higher than other countries. In Italy, both total and per capita consumption did not change much, with the exception of the 1970s and 80s. Germany also remained stable compared to others. In 2018, the top countries for rabbit meat consumption included China, Spain, Italy and France. China's total consumption in 2018 reached 858.56 thousand tonnes, while Spain, France, and Italy consumed 49.43, 46.15 and 44.34 thousand tonnes, respectively. In terms of per capita consumption, Spain ranked first with 1.109 kg, followed by Italy and France with 0.724 and 0.632 kg. Per capita consumption in China is 0.601 kg on average.

In above analysis on production, trade and consumption, it can be seen that: (1) with the regional change of production from Europe to Asia, consumption also basically evolves following the same path; (2) the inter-continental trade (mainly between Europe and Asia) is gradually decreasing, but inner-continental trade increases, especially within European countries; (3) consumption in Asia is gradually stimulated, especially in China, the per capita consumption reached 0.601 kg in 2018, which is near the levels of France (0.632 kg); (4) The long-distance traded rabbit meat is mainly frozen product, but now consumers prefer more to fresh meat. This may be the reason why trade between Europe and Asia decreases.

Comparative advantages and competitiveness

Theoretically, trade is determined by both production and consumption. But whether one country has advantages or competitive edge is mainly determined by resource endowment. This section will calculate RCA to compare the advantages among major countries and study the changes in one country (Table 5).

The results show that since 2000 Hungary and Argentina have been two strong competitors in the rabbit meat market. Argentina is gradually losing its advantages, although it is still ranked second for now. Spain and Belgium are another two strong competitors. Over the past two decades, their RCAs have been increasing continuously. As a traditional producer and exporter, France has basically stable RCAs. In turn, China still accounts for large shares in world rabbit meat production and trade, although in the past 20 yr its advantages have been declining. Netherlands also shows the decreasing trend in RCAs. Overall, Hungary and Argentina have strong comparative advantages, with RCAs of

Table 5: Revealed Comparative Advantage Index (RCA) of major countries (2000-2018).

Year	Argentina	Belgium	China	France	Hungary	Netherlands	Spain
2000	29.35	1.41	8.43	3.50	28.44	3.80	4.79
2001	28.56	1.07	7.66	3.36	25.89	4.00	4.77
2002	32.77	1.68	2.35	4.66	37.19	3.40	5.34
2003	32.09	1.47	0.93	4.47	36.83	1.56	6.72
2004	39.67	2.11	0.98	4.68	28.88	1.38	6.94
2005	49.15	2.47	1.76	4.32	27.93	0.98	6.65
2006	35.76	4.23	1.84	4.40	22.61	1.36	7.01
2007	30.81	4.32	1.98	4.94	24.30	0.98	6.12
2008	33.39	5.17	2.22	6.02	19.32	0.21	4.31
2009	21.58	5.61	2.70	5.47	25.26	0.57	3.43
2010	25.76	6.10	2.40	5.49	25.44	0.84	6.72
2011	24.63	6.88	1.96	6.52	30.18	1.18	5.60
2012	19.39	6.19	2.26	5.63	33.13	1.03	9.07
2013	13.02	6.27	1.97	6.08	35.96	0.79	8.96
2014	11.70	6.11	2.35	5.68	31.31	0.65	9.33
2015	15.12	7.57	1.54	6.06	30.08	0.67	9.50
2016	13.58	5.26	1.06	5.76	25.95	0.67	8.79
2017	13.23	6.62	1.64	6.58	29.33	0.55	9.61
2018	13.34	7.56	1.33	5.52	26.29	1.68	8.93

Data source: FAO statistics, http://www.fao.org/faostat/en/, and WITS database, http://wits.worldbank.org/WITS/.

26.29 and 13.31 in 2018, followed by Spain and Belgium, RCAs of which are respectively 8.93 and 7.56, while the Netherlands and China have the lowest RCAs and France is in the middle.

Driving forces of regional trade: Gravity model results

As introduced in the methodology section, the major factors affecting trade have been figured out, including: (1) resources endowment, which determines the production cost and prices; (2) distance between two countries, which determines the time required to ship meat from exporter to importer. The distance is also related to marketing cost and convenience; (3) income and population, which reflect purchasing power; (4) same preference and tradition, which can cause more interaction and trade; (5) trade policy; free trade policy can improve trade.

In order to capture the impacts of all these factors, the gravity model is set up with following variables: (1) GDP of the exporting country (GDP_i), to capture the resources endowment, as those countries with rich resource endowment usually have a high GDP level. For the importing country, GDP mainly reflects consumers' purchasing power, which is the potential for meat imports; (2) population of exporting country (POP_i) and importing country (POP_j), to capture the demand for rabbit meat; (3) distance between country i and j (DIS_{ij}), to denote the marketing cost; the short transport time also means the meat is fresher. Contiguity (BOR_{ij}) is also specified to capture the similarity of two countries in consumption tradition, and also reflects fast transport and convenience; (4) Common language. Language is a very important communication tool in trade. If two countries share a common official or primary language, it is easier for them to trade. The same language also means they may have similar habits; (5) free trade or trade protection will cause different results. GATT/WTO membership is introduced to reflect the policy intervention. If one country is a WTO member, this also means its trade should be freer.

The model is run by STATA econometric software and the results are listed in Table 6. It can be seen that most variables are significant in export, import and total trade models. GDP of the exporting country is negatively significant, which shows that when the exporting country has a higher GDP, the rabbit meat trade will decrease. But if the importing country has a higher GDP, the trade will increase. This shows that trade is mainly driven by demand. High GDP means high income; high income drives greater consumption. China is a typical case. China has a large GDP and a high GDP growth rate, but rabbit meat export has been decreasing for many years. Since the model is in double-log form, the coefficient of variable GDP_i is the GDP elasticity of trade, so when GDP increases by 1 percent in the exporting country, the rabbit meat trade will decrease by 0.76 percent. But if importing countries increase their GDP by 1 percent, their imports will increase by 0.65 percent.

Table 6: Gravity model results.

Variable	Export Model	Import Model	General Trade Model
GDP_i: GDP of exporting country (current US$)	–0.76*** (–9.34)	–0.84*** (–7.25)	–0.76*** (–11.69)
GDP_j: GDP of importing country (current US$)	0.67*** (13.90)	0.84*** (4.32)	0.65*** (15.31)
POP_i: population of exporting country (mn)	0.99*** (11.78)	1.36*** (11.50)	1.16*** (16.81)
POP_j: population of importing country (mn)	–0.13** (–2.24)	–0.80*** (–3.78)	–0.20*** (–3.71)
DIS_{ij}: distance between country i and j (km)	–0.47*** (–5.42)	–0.38*** (–4.76)	–0.44*** (–7.89)
WTO_i: Origin country i is GATT/WTO member, yes=1, otherwise=0	0.52 (1.38)	0.67 (1.30)	0.85*** (2.83)
WTO_j: Destination country j is GATT/WTO member, yes=1, otherwise=0	0.16 (0.8096)	–0.79 (–1.6331)	0.10 (0.59)
$Lang_{ij}$: Common official or primary language, yes=1, otherwise=0	0.61*** (4.26)	–0.76*** (–3.40)	0.14 (1.16)
BOR_{ij}: Contiguity, yes=1, otherwise=0	1.59*** (9.32)	1.78*** (9.95)	1.56*** (12.63)
Cons	12.21*** (5.201)	10.94** (2.35)	11.71*** (5.93)
N	2259	1339	3598
R-sq	0.37	0.25	0.33

*P<0.1; **P<0.05; ***P<0.01; t-value in parentheses. GDP: Gross Domestic Product.

Population is significant in the three models. It shows that the larger the population of the exporting country, the more exports of rabbit meat there will be. However, in importing countries, the effect is the opposite. Therefore, if exporting countries have a higher population, there will be a decline in rabbit meat imports. This may be due to the low labour cost in countries with higher populations. Nowadays, in many countries rabbit rearing is still labour-intensive compared with other sectors, so a larger population means a strong comparative advantage in rabbit raising in these countries, as they can finally meet their domestic demand for rabbit meat, thus reducing imports. This also shows that the demand for rabbit meat is driven mainly by increasing income (GDP) rather than population growth. In many countries, youngsters do not eat as much as their older generations.

Luo and Wu (2019) compared the minimum monthly wage in major rabbit raising countries. In the past three years (2016-2018), the average minimum monthly wages have been high in Netherlands (1700 USD), Belgium (1695 USD), France (1622 USD) and Spain (846USD), but low in Hungary (394 USD), Brazil (237USD) and China (230USD). Labour is the key factor in the rabbit industry.

DIS (Distance between two countries) is significant, but negatively. This means trades import more from far distant countries instead of nearby, and it is apparently irrational. The reason may be due to the measurement of distance between two countries. In models, the DIS variable is measured by the distance *between capitals of two countries*, but rabbit rearing is usually not allowed within cities, especially the capital city. In most countries, rabbit is raised outside the city. This may also explain why one country both imports and exports a lot, as do Belgium, France and Italy. In 2018, Belgium exported 5639 tonnes rabbit meat, but also imported 5276 tonnes. It seems that in one bordering and producing area, rabbit is exported to the neighbouring country; in 2018, Belgium mainly exported rabbit meat to France, the Netherlands and Germany etc. But in the opposite area (consumption region) they may import from their neighbouring countries or other countries with low prices. In 2018, Belgium mainly imported from China, France, Argentina, Spain, the Netherlands and Germany. Since the data of domestic regional rabbit meat trade pattern in Belgium cannot be collected, detailed studies on exporting and importing areas within Belgium cannot be carried out here. BOR (whether two countries are neighbours) is positively significant, which means contiguity is important in the rabbit meat trade. If both distant and contiguity variables are considered, nearby countries should be the key factor affecting rabbit meat trade.

Language (whether two countries have the common official or primary language) is significant in the export model and the import model, but not in the general trade model. This shows that exporting countries try to sell rabbit meat to those countries with the same language. Nevertheless, for the importing countries, what they pursue may be low price, instead of the same language or tradition.

WTO membership is generally not significant, except for the exporting country in the general trade model. This means that a free trade policy in the exporting country can improve exports. But in other cases, whether these countries are WTO members is not important. This may be because most trading countries have already been WTO members.

CONCLUSIONS

In the past 60 yr, the rabbit industry has achieved great progress worldwide. In the first 30 yr, that is before 2000, rabbit meat was mainly produced in Europe, but in the last 20 yr meat production has moved to Asia. In 2000, rabbit meat output in Asia (428.66 thousand tonnes) first surpassed that of Europe (356.42 thousand tonnes). In 2018, Asia and Europe produced 72.71 and 19.43% of global rabbit meat, respectively, while the shares of Africa and Americans were respectively 6.65 and 1.21%.

Unlike production, rabbit meat trade only increased for about 20 yr from 1961 to 1979. After 1979, the global rabbit meat trade fluctuated around 60 thousand tonnes for another 20 yr. Since 2001, it has been stable at the level of 37 thousand tonnes, with little fluctuation. Increasing production but stable and decreasing trade show that rabbit meat is gradually being consumed locally. The trade pattern is currently from Asia (mainly China), South America (mainly Argentina) and Europe (Spain, Belgium, and France) to European countries. In 2018, the top 5 destinations were Germany, Belgium, Italy, Portugal and France.

As regards comparative advantage, Hungary and Argentina have been two strong competitors in the past two decades, while Spain and Belgium are gradually becoming two promising countries in the rabbit meat trade. China

was always a strong exporter, but in the last decade domestic demand has been increasing rapidly, which replaces the exports. France is a special case that has been a key player in production, trade and consumption for about 50 yr.

The gravity model results show that rabbit meat trade is mainly driven by demand. The countries with high GDP tend to increase imports of rabbit meat but decrease their exports. As for production, countries with higher populations means low labour costs and greater comparative advantages in rabbit meat production and exports, so they export more. A common language and border denote similar traditions and dietary habits. This also significantly affects trade.

Based on the above results, some suggestions and policy implications are provided: (1) Since rabbit meat is more traded locally or between neighbours, rabbit farmers or processing companies should pay more attentions to domestic consumers or neighbouring countries to exploit the market potential. (2) The experiences of France and Italy show that expanding multi-channels for export can reduce risks and maintain positions stable for a long time, so traders should explore more markets in order to reduce the degree of trade concentration and avoid risks. (3) Population has significant negative effects on rabbit meat imports, which means that newer generations consume less rabbit meat. Governments should popularise the nutritional knowledge of rabbit meat so as to encourage people (especially young people) to consume more healthy rabbit meat, with a view to reducing obesity, heart diseases or other illnesses from fatty pork or other unhealthy meats.

Acknowledgements: This paper aims to study the global rabbit industry by focusing on trade, including trade development in the last 50 yr, regional patterns and evolution, driving forces of trade, etc. Our special thanks are given to President Thierry Gidenne and the Committee of the 12th World Rabbit Congress. This research is also partly funded by China Rabbit Research System (2011-2020). Many thanks also go to the chief scientist and my colleagues.

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