

## **RABBIT MEAT TRADE OF MAJOR COUNTRIES: REGIONAL PATTERNS AND INFLUENCING FACTORS**

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### **ABSTRACT**

In the past 60 years, the global rabbit industry has been growing steadily. This paper studies global rabbit meat trade by focusing on trade growth and regional patterns. First, rabbit meat production and regional structure are introduced, as the basis of trade. Then, global rabbit meat trade is studied in details, including trade growth, regional structural changes, comparative advantages and competitiveness of major countries. Finally, a Gravity model is built to test major factors affecting rabbit meat trade and to explore the behind the trade scenes. The data were collected from different channels, including the UN FAO, the Word Bank, the WTO and related government statistics. The results show that: (1) In past 60 years, global rabbit industry has achieved great progress. In the first half period, rabbit meat was mainly produced in Europe, but in the second half period the meat production level in the Asian countries increased steadily and rapidly, and the producing center moves from Europe to Asia; (2) Rabbit meat trade had been increasing for about 20 years from 1961 to 1979, then it fluctuated for another 20 years. However, since 2001 it has been stable with only small fluctuations, the average output being around 37 thousand tonnes. The trade pattern currently is from the Asian area (mainly China) to European countries. In 2019, the top 5 export destinations were Germany, Belgium, Italy, France and Spain; (3) Hungary has been a strong competitor, Spain and Belgium are two new promising countries in rabbit meat trade. Though the rabbit meat output in China is still increasing, exports have been decreasing in recent decades. China is gradually losing its comparative advantages in rabbit meat trade; (4) The Gravity model results show that the rabbit meat trade is driven mainly by demand. The countries with high GDPs tend to increase imports more, but decrease exports. Countries with a higher population exports more rabbit meat, but import less. Common language and common border of two countries have significant impacts on rabbit meat trade. In this way, some suggestions and policy implications are provided. Rabbit farmers or processing companies should pay more attention to domestic consumers or neighboring countries to exploit the potential markets; traders should explore more markets so as to reduce trade concentration degree and reduce risks; Government should popularize the nutrition knowledge of rabbit meat so as to encourage people (especially young people) to consume more healthy rabbit meat instead of pork and beef, and finally reduce obesity and heart diseases associated with unhealthy diets.

**Key words:** rabbit meat, meat production, meat trade, comparative advantages

### **INTRODUCTION**

In the past several decades, the rabbit industry has contributed much to farmer's income and rural economic growth in many countries. This is attributed to its favorable characteristics, such as flexible investment, easy starting and management, saving grain and land resources, producing high quality meat, and creating jobs for rural people, especially women, younger or elderly people. In many developing countries, rabbit breeding has rescued countless poor people out of poverty. From the global perspective, rabbit meat output has kept steady, increasing for nearly 60 years. According to the statistics of the Food and Agriculture Organization of United Nations (FAO), from 1961 to 1985 world rabbit meat was mainly produced in the Europe, which had been accounting for more than 80%

for about 25 years. However, in following years, the rabbit industry in Asia increased quickly and became a major producing region. In 2019, the global rabbit meat output reached 1.41 million tonnes with European countries accounting for only 12.11%, but Asian countries dominating with a share of 81.75%.

It is clear that rabbit meat producing areas moved from Europe to Asia, but was this regional change of production accompanied by the restructure of rabbit meat trade? How did trade patterns evolve in the past several decades? Does this mean that rabbit meat consumption also moved from Europe to Asia? What are the influencing factors driving the structural change of global rabbit trade? These questions are of great importance to global rabbit industry development. However, there are not many studies in this area. Smutka and Rosochatecka (2010) analyzed global trade of rabbit meat, which showed that rabbit meat production and trade had been constantly increasing. The research by Niedzwiadek (1994) showed that the major producing countries of rabbit meat were Italy, France, China and Spain. The consuming areas included Italy, France, Spain, Belgium, Portugal and Malta, where per capita consumption ranged from 2.0 kg to 5.3 kg. Some research studies focused on specific country or region. Adanguidi (2020) studied the profitability and competitiveness of rabbit value chains in Benin. Golban and Golban (2020) analyzed the competitiveness of rabbit meat produced in the Republic of Moldova. Szendro (2015), Szendrő Zs and Bleyer F. (1999) studied rabbit meat production and trade in Hungary. Popescu-Miclosanu and Stanciu (2013) analyzed the development of both world and Romanian meat rabbit production and trade balance.

Compared with trade research, there are more studies about rabbit meat production and consumption. Cullere and Zotte (2018) showed that rabbit meat had many good characteristics and could be considered as an ideal meat producing animal, but the consumption in the world is not popular. McNitt et al. (2013) summarized the rabbit production in major areas of the world, and discussed about future of world rabbit production and rabbit research. Before the 1990s, related studies mainly focused on meat supply in order to meet higher demand (Owen 1981; Parkin 1972; Roberts 1980). Recently, more reports focused on production systems, technology and efficiency subjects. Trocino et al. (2019) evaluated the availability of research funds and scientific activities relating to rabbits in Italy, Europe and all over the world during past 20 years. Khan et al. (2017) examined the production performance of indigenous rabbits under traditional and intensive systems in Pakistan. Lukefahr et al. (2004) reviewed the limitations of meat rabbit production in North America. From the perspective of rabbit meat consumption, some scientists focused on specific groups of people, including children and university students (Escriba-Perez et al. 2019; Gonzalez-Redondo et al. 2010), but most of this research was concentrated on only one country, including Italy, France, Hungary, Spain, the USA and Mexico (Beal et al. 2004; Bodnar and Horvath 2008; Chalah and Hajj 1996; Dairo et al. 2012; Kowalska 2015; Olivares et al. 2005; Petracci et al. 2018). Sanah et al. (2020) studied the motivation and obstacles to rabbit meat consumption in Algeria. Sugiyama et al. (2017) studied the meat consumption in Mexico from the view of ecological and social contexts. Szendro et al. (2020) focused on the production methods and purchase forms in eight countries to study consumers' attitude to consumption of rabbit meat.

There is a large body of multidiscipline research on rabbit science, which covers rabbit meat quality and nutrition, rabbit behavior and welfare, etc. Many researchers studied the impacts of different factors affecting rabbit meat quality, including cage and pen housing (Combes et al. 2010; Matics et al. 2019), limited feed intake (Chodova et al. 2019; Gidenne et al. 2012), different feed additives (Dabbou et al. 2017; Wahyuni et al. 2018). Cavani et al. (2009) reviewed the advances in research on poultry and rabbit meat quality. Antipov et al. (2020) studied technology to increase the shelf-life of dietary-influenced rabbit meat in a supercooled-frozen state, while maintaining organoleptic properties using a stabilized cooling system. Lehmann (1991), [ENREF 4](#) examined the social behavior in young rabbits under semi-natural conditions. Verga et al. (2009) analyzed the welfare aspects in rabbit rearing and transport, while Nielsen et al. (2020) focused on health and welfare of rabbits which were farmed in different production systems. There are also many research studies on rabbit industry competitiveness of major countries (Foster and Telford 1996; Luo and Wu 2019; Wu and Qin 2019). Therefore, there is much knowledge about the principal subjects inside rabbit science, but there is a

lack of the research on rabbit meat trade. The objective of this paper is to study trade growth of global rabbit meat in past decades and its influencing factors. We will focus on the development and trends of rabbit meat trade, regional structure and their determinants.

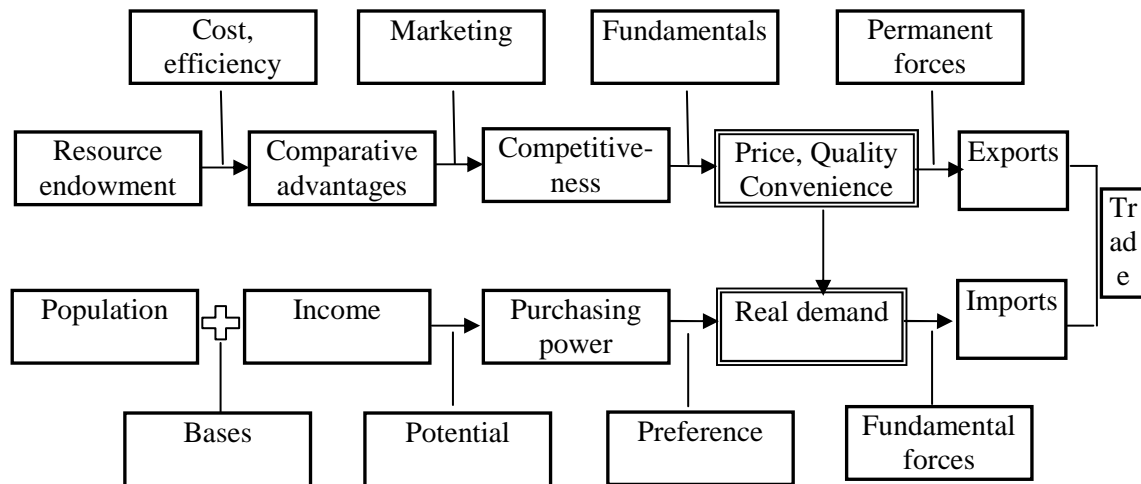
## MATERIALS AND METHODS

### Analytical framework and Data

Theoretically, trade is determined by the *comparative advantages* of a country. The law of *comparative advantage* describes how, under free trade, a country will produce more of a good for which they have low costs or prices, so it can be exported to other countries (Dixit Avinash and Norman Victor, 1980). However, the *comparative advantages* are determined by *Resource endowment*, which refers to the amount of land, labor, capital, and entrepreneurship that a country possesses for production exploitation. More resources mean low prices of resources and low production costs; therefore, countries with a large endowment of resources tend to be more prosperous and more competent than those with a small endowment.

Based on free trade and comparative advantage theory, the mechanism of exports and imports is as following chart (figure 1). From above, we know that resource endowment determines comparative advantages. However, comparative advantages are just the potential for exports, only achieved through effective marketing to attract more buyers, can it become competitive. From the supply side (upper part of the figure 1), price, quality and convenience are the fundamentals of competitiveness. Besides this, they are also the permanent factors that affect exports.

On the other hand, for imports (lower part of figure 1), population and income are the bases of demand. However, they are also the potentials for purchasing or importing. Only by cultivating preferences of consumers, can potential purchasing power become real demand. Therefore, population, income and preference are the fundamental driving forces of imports.



**Figure 1:** International trade and its determinants

Based on above mechanism, from the sides of production and exports, we will focus on *cost, price* and *comparative advantage* of major countries. And from demand and import side, we will focus on *population, income* and *preference change* in major countries. Finally, a *Gravity model* will be applied to test the impacts of these factors on rabbit meat trade.

### Revealed comparative advantage (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 good exports, divided by the share of the world's total export value of the same good in the world's total exports of all goods. The RCA is calculated by equation (1):

$$RCA_{ic} = \frac{\frac{X_{ic}}{X_{it}}}{\frac{X_{wc}}{X_{wt}}} \quad (1)$$

where  $RCA_{ic}$  represents the revealed comparative advantage index of good  $C$  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 the 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 that, 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):

$$T_{ij} = a_0 Y_i^{a_1} Y_j^{a_2} D_{ij}^{a_3} A_{ij}^{a_4} \quad (2)$$

Where  $T_{ij}$  is the trade between country  $i$  and  $j$ ,  $Y_i$  and  $Y_j$  are respectively GDPs of country  $i$  and  $j$ ,  $D_{ij}$  is the distance between two countries,  $A_{ij}$  denotes trade policy and other factors and  $a_0, a_1, a_2, a_3, a_4$  are coefficients.

Trade includes exports and imports, so we will build both export and import models, which are specified as followings:

$$\ln EX_{ij} = a_0 + a_1 \ln GDP_i + a_2 \ln GDP_j + a_3 \ln POP_i + a_4 \ln POP_j + a_5 \ln DIS_{ij} + a_6 \ln WTO_{ij} + a_7 BOR_{ij} + a_8 Langu_{ij} + \mu_{ij} \quad (3)$$

$$\ln IM_{ij} = b_0 + b_1 \ln GDP_i + b_2 \ln GDP_j + b_3 \ln POP_i + b_4 \ln POP_j + b_5 \ln DIS_{ij} + b_6 \ln WTO_{ij} + b_7 BOR_{ij} + b_8 Langu_{ij} + \sigma_{ij} \quad (4)$$

$EX_{ij}$  and  $IM_{ij}$  represent respectively exports and imports from country  $i$  to country  $j$ .  $GDP$  and  $POP$  are Gross Domestic Product and population.  $DIS_{ij}$  stands for the distance between two countries.  $WTO_{ij}$  refers to the membership in GATT/WTO, if one country is member of GATT/WTO, it will be 1, otherwise 0.  $BOR_{ij}$  denotes adjacency of two countries, if two countries are neighbours, it will be 1, otherwise 0.  $Langu_{ij}$  represents the language, if two countries have 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.  $\mu_{ij}$  and  $\sigma_{ij}$  are disturbance.

To capture the general effects of above factors on both exports and imports, the general trade model will also be estimated, so there are three models as following: (1) model 1: *export determination model*, which is specified as equation 3; (2) model 2, *import determination model*, which is specified as equation 4; (3) model 3, *general trade model* (total trade volume of exports and imports). The data in all these models cover the years from 1990 to 2018. In model 1, the top 6 exporting countries and their partners are selected as a sample, the sample number is 2259. In model 2, the top 6 importing countries and their partners are selected as a sample, the sample number is 1339. In model 3, these two samples are combined together, so the total sample is 3598.

Data used in this paper come from different channels: rabbit meat production data was from FAO statistics bank, the trade and WTO membership data were collected from the World Trade

Organization, the data of distance between countries were from CEPII Database<sup>1</sup>. GDP and Population were from World Bank, and other data were from related country government statistics. The models were estimated by econometric software STATA 14.

## RESULTS AND DISCUSSION

### Global rabbit meat production and regional structure

The rabbit is a small animal species that needs less feed with a low feed conversion ratio. Generally, feed costs could be reduced through the utilization of homegrown or less expensive feedstuffs, labor 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 the rabbit industry a much higher priority in policy making for poverty reduction.

From the development of global rabbit production (Table 1), it can be found: (1) the rabbit industry has experienced rapid growth since 1961. Meat output increased from 397 thousand tonnes (1961) to 1.410 million tonnes (2019) with annual growth rate of 2.21% (figure 2); (2) The period of rabbit meat production from 1961 to 2019 can be divided into three phases, *fast increase* (1961-1980), *adjustment/transition period* (1981-1990), and *steady increase* (1991-). The growth rate during these three periods are respectively 3.22%, 0.89% and 4.57%; (3) meat output growth in the first period mainly took place in the Europe with an average share of 85.99%, while the Asian countries only accounted for 7.87%. After adjustment in the transition period from 1981 to 1990, the major producing area moved from the Europe to Asia. Since 1991, rabbit meat output in the Europe has been continuously decreasing, but that of the Asian countries has continuously increased. The shares of the European rabbit meat decreased from 67.96% (1991) to 12.11% (2019), but during the same period, rabbit meat output in the Asian countries increased from 17.55% to 81.75%. In 2019, the rabbit meat outputs in the Asian and European countries were 1.15 million tonnes and 0.17 million tonnes, respectively.

**Table 1:** Global rabbit meat production in major years from 1961 to 2019

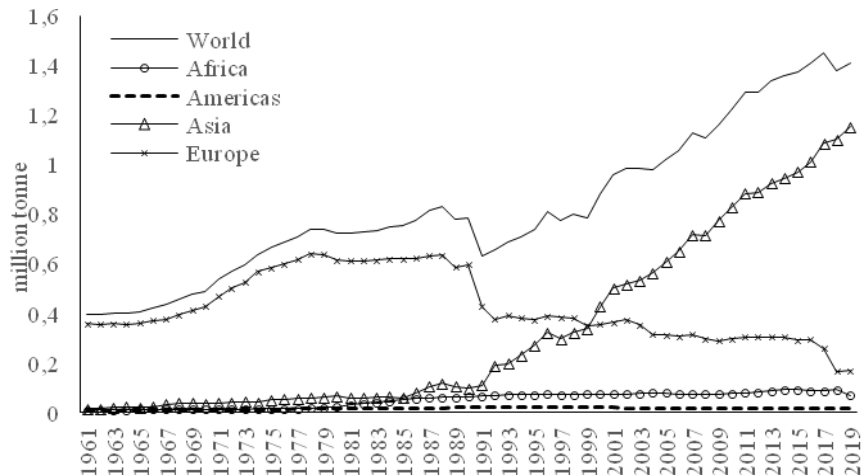
Year	World	Europe		Asia		Africa		Americas	
		Quantity (tonne)	Portion (%)	Quantity (tonne)	Portion (%)	Quantity (tonne)	Portion (%)	Quantity (tonne)	Portion (%)
1961	397.06	359.41	90.52	15.66	3.94	11.73	2.96	10.26	2.58
1966	421.68	372.68	88.38	24.27	5.76	13.61	3.23	11.12	2.64
1971	537.66	470.70	87.54	40.84	7.59	15.09	2.81	11.04	2.05
1976	686.79	601.04	87.51	54.68	7.96	16.36	2.38	14.71	2.14
1981	723.11	613.03	84.78	60.58	8.38	31.45	4.35	18.06	2.50
1986	776.98	622.44	80.11	79.63	10.25	57.48	7.40	17.43	2.24
1991	630.83	428.73	67.96	110.69	17.55	68.70	10.89	22.70	3.60
1996	809.58	390.83	48.28	323.47	39.96	74.28	9.17	21.00	2.59
2001	961.71	363.61	37.81	501.97	52.20	75.01	7.80	21.13	2.20
2006	1055.02	307.47	29.14	652.08	61.81	76.70	7.27	18.77	1.78
2011	1289.98	306.28	23.74	885.22	68.62	80.93	6.27	17.55	1.36
2016	1411.74	294.36	20.85	1012.65	71.73	89.01	6.30	15.72	1.11
2017	1450.31	259.21	17.87	1086.44	74.91	89.07	6.14	15.58	1.07
2018	1377.83	168.43	12.22	1100.86	79.90	92.64	6.72	15.91	1.15
2019	1410.11	170.75	12.11	1152.72	81.75	71.12	5.04	15.52	1.10

Data source: FAO Statistics, <http://www.fao.org/faostat/en/>.

From the perspective of major producing countries, during the 1960s and 1970s, France was the largest producer, and Italy ranked second. In the 1960s, these two countries produced more than 58.68% of global rabbit meat, and in 1970s they still produced more than 45.93%. In 1979, Italy became the largest producer with a portion of 22.23% and for the first time surpassed France (20.93%). This trend continued until 1990. Since 1991, Asian countries stepped on the rabbit market stage, especially China, which in 1991 became the largest producer. It is noteworthy that China's portion increased from 17.12% (1991) to 69.78% (2019)<sup>2</sup>.

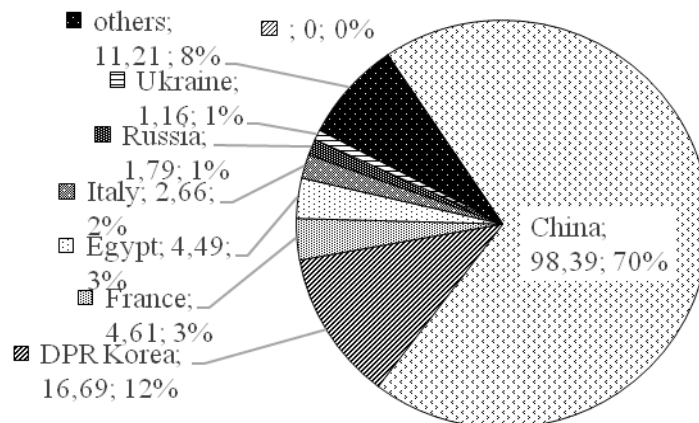
<sup>1</sup> [http://www.cepii.fr/CEPII/en/bdd\\_modele/bdd\\_modele.asp](http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp).

<sup>2</sup> According to the latest statistics of State Statistical Bureau of China, the rabbit meat output in China was 46.6 thousand tonnes in 2018. However, this statistic underestimates the rabbit meat output in China since it does not consider small and



**Figure 2:** Global rabbit meat outputs across continents (1961-2019)  
 Data source: FAO Statistics, <http://www.fao.org/faostat/en/>

In 2019, the top five major producing countries were China, D.P.R Korea, France, Egypt and Italy (Figure 3). They totally produced 1.269 million tonnes of rabbit meat<sup>3</sup>, accounting for 84.05% of global total. The share of top ten countries reached 89.95%. Therefore, the concentration rate of production was still high.



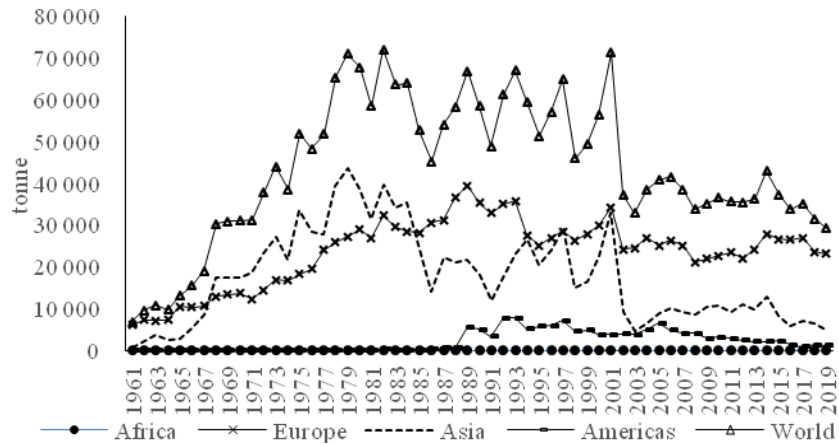
**Figure 3:** Rabbit meat output and shares of main producing countries in 2019  
 Data source: FAO statistics, <http://www.fao.org/faostat/en/>. Unit: tonnes.

### Rabbit meat trade and structural changes

Figure 4 shows the global rabbit meat exports data across continents from 1961 to 2019. It is evident that rabbit meat exports had been increasing for about 20 years before 1980. However, since 1981, exports have been fluctuating for about 20 years at around 58.40 thousand tonnes. After 2001, it has been stable at the level of around 36.97 thousand tonnes with little fluctuation. In 2019 it was 29.23 thousand tonnes. Nevertheless, the destination of rabbit meat exports has been the Europe since 1961 with an average share of 95.26% of total exports. It is clear that before 1985 rabbit meat trade mainly took place between Asia and Europe, but since 1986, it has been traded mainly within the European countries, and with certain supplements from the Asian countries (mainly China).

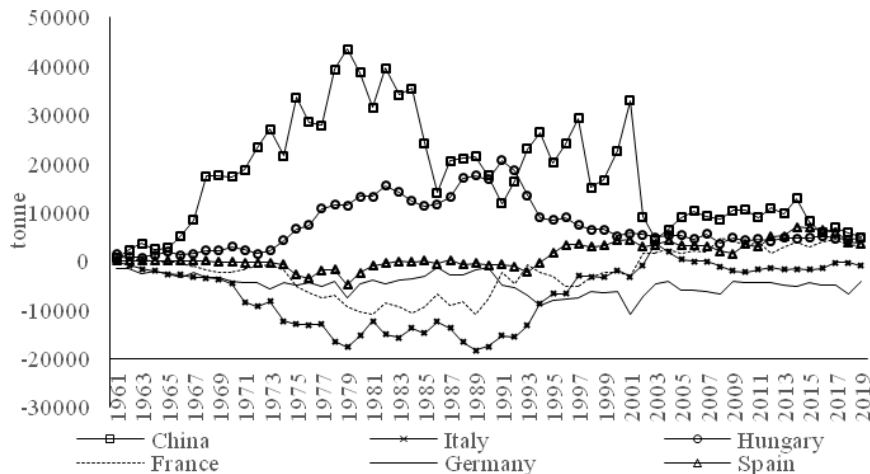
scattered rabbit farmers, with the total number of beginning-year stock and new breeders of less than 20 rabbits. Based on Chinese official statistics, the rabbit meat output in China in 2018 accounted for about 51.1% of global total.

<sup>3</sup> The rabbit meat output in France is still not released in the FAO statistics bank, here is the estimation by average of three-year output from 2016 to 2018.



**Figure 4:** Global rabbit meat exports across continents (1961-2019)  
 Data source: FAO Statistics, <http://www.fao.org/faostat/en/>

Concerning major trading countries, for many years, China, France and Hungary have been the major exporters. Since 2001, rabbit meat exports from Spain increased quickly. During the same period, the major importing countries included Germany, France and Italy. Figure 5 shows the net exports<sup>4</sup> of major countries since 1961.



**Figure 5:** Net export of rabbit meat in major countries (1961-2019)  
 Data source: FAO Statistics, <http://www.fao.org/faostat/en/>.

It is clear that during the period of 1960s and 1970s, rabbit meat was mainly exported from China and Hungary to Italy, France and Germany. However, from the beginning of 1980s, the exported rabbit meat from China started to decline, and since 1990s the exports from Hungary have 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 have been stable now for about ten years. This situation shows that the self-sufficiency rate of major importing countries is increasing.

There were 40 countries exporting rabbit meat in 2019. The top 10 exporting and importing countries are listed in Table 2. It can be seen that the top 5 exporting countries were France, Spain, China, Hungary and Belgium. They exported 25428 tonnes of rabbit meat, accounting for 73.16% of global total rabbit meat exports in 2019. The top 10 countries exported 29731 tonnes, accounting for 85.54% in 2019. Except for China and Argentina, other top 10 countries are all from European. Different from exports, the rabbit meat imports data are more scattered. In 2019, a total of 63 countries imported rabbit meat. The top 5 were Germany, Belgium, Italy, France and Spain. Collectively, they imported 19083 tonnes, accounting for 54.02% of global total imports. The share of the top 10 countries is 71.95%. Except for the United States, the other importing countries in the top 10 were from Europe, therefore Europe is still a traditional area of rabbit meat consumption.

<sup>4</sup> Net exports are equal to exports minus imports. It is the sole contribution of one country to global market. If net exports are greater than 0, it means that this country exports more than imports, and vice versa.



**Table 2: Top 10 countries of rabbit meat export and import in 2019**

Export					Import				
Country	Quantity (tonne)	Share (%)	Value (million USD)	Share (%)	Country	Quantity (tonne)	Share (%)	Value (million USD)	Share (%)
1 France	5958.02	17.14%	27.72	15.81%	1 Germany	5485	15.53%	33.24	18.10%
2 Spain	5538.81	15.94%	23.17	13.22%	2 Belgium	5174	14.65%	29.47	16.05%
3 China	4897.04	14.09%	23.01	13.12%	3 Italy	3388	9.59%	14.31	7.79%
4 Hungary	4731.04	13.61%	28.49	16.25%	4 France	2870	8.13%	10.73	5.84%
5 Belgium	4303.68	12.38%	25.26	14.41%	5 Spain	2166	6.13%	8.31	4.53%
<b>Top 5 sum</b>	<b>25429</b>	<b>73.16%</b>	<b>127.64</b>	<b>72.81%</b>	<b>Top 5 sum</b>	<b>19083</b>	<b>54.02%</b>	<b>96</b>	<b>52.31%</b>
6 Italy	1431.43	4.12%	5.85	3.34%	6 Portugal	2046	5.79%	8.74	4.76%
7 Netherlands	960.79	2.76%	6.90	3.94%	7 Netherlands	1308	3.70%	8.06	4.39%
8 Argentina	768.61	2.21%	5.04	2.87%	8 United States	1141	3.23%	5.19	2.83%
9 Portugal	647.50	1.86%	3.42	1.95%	9 Czech Republic	1111	3.15%	5.82	3.17%
10 United Kingdom	494.69	1.42%	2.27	1.29%	10 Switzerland	728	2.06%	6.29	3.42%
<b>Top10 sum</b>	<b>29732</b>	<b>85.54%</b>	<b>151.11</b>	<b>86.20%</b>	<b>Top 10 sum</b>	<b>25416</b>	<b>71.95%</b>	<b>130.17</b>	<b>70.87%</b>
<b>Global total</b>	<b>34758</b>	<b>100%</b>	<b>175.30</b>	<b>100%</b>	<b>Global total</b>	<b>35322</b>	<b>100%</b>	<b>183.65</b>	<b>100%</b>

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

Note: theoretically global exports are equal to global imports, however, there is difference due to statistical or other errors. The error rate of trade volume is 1.60%.

There is an interesting phenomenon here, that is, one country both exports and imports rabbit meat. In economics it is called *intra-industry trade*. From table 2 it can be found that the intra-industry trade mainly took place in Belgium, France and Italy. To understand in more detail, we selected three countries (Belgium, France and Italy) to study their trade pattern (table 3). In 2019, Belgium exported rabbit meat to 28 countries, but mainly to 5 countries, which accounted for 90.32%. France exported to 52 countries or regions, but the top 5 and top 10 countries accounted for 70.08% and 90.46%, respectively. Italy exported to 28 countries, and 69.74% was exported to top 5 countries and 91.43% to top 10 countries. Compared with exports, the imports of these three countries were more concentrated in fewer countries. Belgium imported from 15 countries, France and Italy imported from 16 and 12 countries, respectively.

Theoretically, intra-industry trade may be due to the distance among countries, or product diversity, etc. The impacts of distance and borders between two countries will be tested later in the Gravity model. There are also some other explanations, such as differentiation of products. Rabbit meat is not homogeneous, which includes fresh or frozen meat, or different processing, and it may involve different parts (e.g. head, leg), etc. Some economists also explain this fact based on the perspective of technology.

The data from table 2 suggest that the trade concentration degrees<sup>5</sup> are much lower in France and Italy. Low concentration degree means more trade partners and less risk. This explains why they can maintain a long-term trade position in the global rabbit meat market, without much fluctuation.

**Table 3: Intra-industry trade of Belgium, France and Italy in 2019**

Belgium 28 Export partners			France 52 Export partners			Italy 28 Export partners		
Top 10 Destination	Quantity (tonne)	Share (%)	Top 10 Destination	Quantity (tonne)	Share (%)	Top 10 Destination	Quantity (tonne)	Share (%)
France	1528	35.50	Italy	1721	28.88	Germany	331	23.15
Germany	1056	24.54	Spain	742	12.46	Malta	287	20.04
Netherlands	813	18.90	Belgium	584	9.81	Hungary	153	10.70
China	325	7.56	United Kingdom	578	9.71	Hong Kong, China	126	8.80
Luxembourg	164	3.82	Germany	550	9.23	Vietnam	101	7.04
United Kingdom	100	2.33	United States	442	7.41	Greece	74	5.17
Poland	84	1.95	China	375	6.29	Poland	73	5.12
Hong Kong, China	77	1.79	Netherlands	158	2.66	France	72	5.04
Vietnam	51	1.19	Greece	136	2.28	China	65	4.56
Italy	49	1.13	Malta	103	1.74	Romania	26	1.81
Sum of top 5	3887	90.32	Sum of top 5	4176	70.08	Sum of top 5	998	69.74
Sum of top 10	4248	98.72	Sum of top 10	5390	90.46	Sum of top 10	1309	91.43
Total export	4304	100	Total export	5958	100	Total export	1431	100

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

(continued)

<sup>5</sup> Trade concentration degree, or concentration ratio, is usually used to show the extent of trade control of one country in global trade. For one country, low concentration ratio means more trade partners and low risks.



<b>Belgium</b> <i>17 Import partners</i>			<b>France</b> <i>19 Import partners</i>			<b>Italy</b> <i>16 Import partners</i>		
Import Origins	Quantity (tonne)	Share (%)	Import Origins	Quantity (tonne)	Share (%)	Import Origins	Quantity (tonne)	Share (%)
China	1896	36.65	Belgium	1352	47.11	France	1174	34.66
Argentina	881	17.02	China	966	33.64	Spain	688	20.29
France	700	13.54	Spain	281	9.78	Poland	428	12.63
United Kingdom	477	9.21	Hungary	95	3.30	Hungary	280	8.27
Spain	353	6.83	Argentina	67	2.34	Germany	183	5.40
Netherlands	323	6.24	Italy	37	1.29	Finland	147	4.35
Poland	228	4.40	United Kingdom	18	0.61	Slovenia	134	3.96
Germany	107	2.07	Uruguay	13	0.44	Argentina	132	3.90
Uruguay	99	1.91	Austria	11	0.38	Netherlands	94	2.77
Chile	66	1.28	Poland	10	0.35	Belgium	92	2.71
Sum of top 5	4307	83.24	Sum of top 5	2760	96.16	Sum of top 5	2753	81.25
Sum of top 10	5130	99.15	Sum of top 10	2848	99.24	Sum of top 10	3352	98.94
Total import	5174	100	Total import	2870	100	Total import	3388	100

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

Trade can be driven either by production or consumption. In following section, we will study the total rabbit meat consumption patterns in major countries. Firstly, total consumption in each country was calculated by the following method:

$$\text{Total consumption} = \text{total output} + \text{imports} - \text{exports}$$

Based on FAO statistics, the total and per capita consumption in major countries were calculated and illustrated in table 4. There are two prominent countries: France and China. In France, both total consumption and per capita consumption of rabbit meat show a sharp decreasing trend since 1961. In contrast, both total and per capita consumption in China tended to increase continuously since 1961. These two countries show significant substitution. The per capita consumption in France decreased from 4.084 kg (1961) to 0.654 kg (2019). However, in China, during the same period it increased from 0.015 kg to 0.683kg.

**Table 4:** Rabbit meat consumption in major countries (1961-2019) unit: tonne, kg

Year	<b>France</b>		<b>Italy</b>		<b>Germany</b>		<b>Spain</b>		<b>China</b>	
	Total (tonne)	Per capita (kg)	Total (tonne)	Per capita (kg)	Total (tonne)	Per capita (kg)	Total (tonne)	Per capita (kg)	Total (tonne)	Per capita (kg)
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	776.57	0.555
2015	49.30	0.765	56.83	0.938	38.30	0.468	47.21	1.011	805.53	0.573
2016	44.59	0.690	57.99	0.956	38.05	0.463	53.24	1.142	851.41	0.602
2017	41.20	0.635	29.01	0.478	37.63	0.455	51.31	1.100	923.14	0.650
2018	40.75	0.627	24.08	0.397	39.95	0.481	51.97	1.113	942.70	0.660
2019	42.60	0.654	27.62	0.456	38.54	0.461	53.98	1.155	979.06	0.683

Data source: FAO Statistics, <http://www.fao.org/faostat/en/>. Total consumption is calculated by: output + imports - exports.

Like China, Spain also showed an increasing trend but with low growth rate and slight fluctuations. However, in 2019, per capita consumption in Spain reached 1.155 kg, which was higher than other countries. In Italy, both total and per capita consumption did not change much with the exception of 1970s and 1980s. Germany also was stable compared with other countries. In 2019, the top countries

of rabbit meat consumption included China, Spain, Italy and France. The total consumption of China in 2019 reached 979.06 thousand tonnes. Whereas in Spain, France and Italy, the consumption figures were 53.98, 42.60 and 27.62 thousand tonnes, respectively. In terms of per capita consumption, Spain ranked the first with 1.155kg, followed by China and France with 0.683kg and 0.654kg.

From the above analysis, it can be found that: (1) with the regional change of production from Europe to Asia, consumption also basically developed the following same path; (2) the inter-continental trade (mainly between Europe and Asia) gradually decreased, but inner-continental trade increased, especially within European countries; (3) consumption in Asia was gradually stimulated, especially in China and per capita consumption reached 0.683 kg in 2019, which is near the level of France (0.654kg); (4) the long-distance trade of rabbit meat mainly involved frozen products, but now consumers mostly prefer fresh meat. This may be the main reason why trade between the Europe and Asia decreased.

### **The comparative advantages and competitiveness**

Theoretically, trade is determined by both production and consumption. However, whether one country has advantages or competitiveness is mainly determined by resource endowment. In this section, calculations of RCA will be made to compare the advantages among major countries and study the changes of one country (Table 5).

The results show that since 2000, Hungary and Argentina had been two strong competitors in the rabbit meat market, although for more than 10 years now, Argentina has exported very little. According to the FAO statistics, in 2019 Argentina exported 768.61 tonnes of rabbit meat and ranked at top 8 in all exporting countries. Spain and Belgium were two other strong competitors. During the past two decades, their RCAs have been increasing continuously. As a traditional producer and exporter, France has maintained stable RCAs. However, China still accounted for largest share in world rabbit meat production and trade, although in the past 20 years its advantages have been declining. Netherlands also showed a decreasing trend in RCAs. In all, Hungary and Argentina had strong comparative advantages with RCAs of 26.29 and 13.31 in 2018 with the following countries being Spain and Belgium (RCAs are 8.93 and 7.56, respectively), while the Netherlands and China had lowest RCAs, and France was intermediate.

**Table 5:** Reveal Comparative Advantage Index (RCA) of main 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/>.

### **Driving forces of the global rabbit meat trade: Gravity model results**

As introduced in the methodology section, the major factors affecting trade have been determined, including: (1) resources endowment, which determines the production cost and prices; (2) distance

between two countries, which determines the time to ship meat from exporters to importers. The distance is also related to marketing costs and convenience; (3) income and population, which determines purchasing power; (4) preferences and traditions. The similar preferences and traditions can cause more interaction and trade; and (5) trade policy. Free trade policy can improve trade.

To capture the impacts of all these factors, the Gravity model is set up by incorporating the following variables: (1) GDP of exporting country ( $GDP_i$ ), to capture the resources endowment and production factors since the countries with richer resource endowment usually have the highest GDP level. For an importing country, GDP mainly reflects consumers' purchasing power, which is the potential for rabbit meat imports; (2) population of exporting country ( $POP_i$ ) and importing country ( $POP_j$ ) are included to capture the demand for rabbit meat; (3) distance between country i and j ( $DIS_{ij}$ ), to denote the marketing costs. The short-distance transportation means fresher meat, which is the key factor attracting consumers. Adjacency ( $BOR_{ij}$ ) is specified to capture the similarity of two countries in consumers' preferences and traditions, it also reflects fast transportation and convenience; (4) Common language. On one hand, language is a very important communication tool in trade. If two countries have a common official or primary language, it is easier for them to trade. On the other hand, the same language also means that they might have similar habits. Though the same language may not always cause trade, compared with the multi-language countries, the same language may cause more trade. By employing the Gravity model, this hypothesis will be tested and (5) free trade or trade protection will cause different results. GATT/WTO membership is introduced to the model to control the variable of policy intervention. If one country is a WTO member, this also means it may trade more freely.

The Gravity model results are listed in table 6. It can be found that most variables are significant. The GDP of the exporting country is negative and significant, which shows that when an exporting country has higher GDP, the rabbit meat trade will decrease. However, if an importing country has higher GDP, the trade will increase. This shows that trade is mainly driven by demand. High GDP means high income and this causes more consumption. China is a typical case. It has high GDP level and GDP growth rate, but rabbit meat exports have been decreasing for many years. Since the model takes the double-log form, the coefficient of variable  $GDP_i$  is the *GDP elasticity of trade*. This means if GDP increase by 1 percent in an exporting country, the rabbit meat trade is predicted to decrease by 0.76 percent. Nevertheless, if importing countries increase their GDP by 1 percent, the import will increase by an estimated 0.65 percent.

**Table 6:** Results of the gravity model

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.

Population was significant in three models. It shows that when the country has a greater population, the exporting country will export a larger quantity of rabbit meat. However, in an importing country, there was an opposite effect. Therefore, if exporting countries have a higher population, rabbit meat imports will decline. This may be due to the low labour costs in countries with a higher population. Presently in many countries, the rabbit breeding is still labor-intensive compared with other sectors; therefore, a higher population means a strong comparative advantage in rabbit breeding, when ultimately they can meet their domestic demand for rabbit meat so as to reduce imports. This also shows that the demand for rabbit meat is driven mainly by income increase (GDP) instead of population growth. Moreover, in many countries, youngsters do not eat as much as their elder generation.

Luo and Wu (2019) compared the minimum monthly wages in main rabbit breeding countries. During 2016 and 2018, the average minimum monthly wages were high in Netherlands (1700 USD), Belgium (1695 USD), France (1622 USD) and Spain (846USD), but were low in Hungary (394 USD), Brazil (237USD) and China (230USD). Labour costs is one of the key factors affecting rabbit industry development.

The coefficient of distance variable (DIS) is negative and statistically significant, suggesting that countries trade more rabbit meat from distant partners. This is in line with our knowledge and most related research findings. Meanwhile, the variable representing adjacency of two trade partners (BOR) has a positive and significant impact in all 3 models. This suggests that neighboring countries are important for rabbit meat trade. Therefore, both distance and adjacency variables show that nearby location should be the key factor affecting rabbit meat trade.

From the regional perspective, the model results can explain the intra-industry trade of rabbit meat. In many countries, rabbit farm is far from the city. In some bordering and producing areas, rabbit meat was exported to the neighboring country, but in other non-producing areas they possibly imported from neighboring countries. In 2019, Belgium exported 3397 tonnes of rabbit meat to its neighboring countries: France, Germany and Netherlands, accounting for 78.98% of its total exports. At the same time, it imported 1960 tonnes from France, the United Kingdom, Spain, Netherland and Germany, which accounted for 37.89%. France is also the similar case, in 2019 it exported 3047 tonnes of rabbit meat to neighboring countries: Italy, Spain and Belgium, accounting for 51.15%, and imported 1633 tonnes from Belgium and Spain, accounting for about 56.89%. Italy mainly exported to Germany and Hungary, but imported from France, Spain, Hungary and Germany, etc.

Language has a significant and positive effect on export, but a negative effect on import. The reason may be that it is easier for exporting countries to promote their products in countries with the same or similar language. Nevertheless, for the importing countries, what was pursued may have been low prices, instead of the same language. Furthermore, the concentration of trade may be another reason. We know from last section that the concentration rate of rabbit meat exports was higher than that of imports. In 2019. A total of 40 countries exported rabbit meat, and the top 5 countries accounted for 73.16%; but the imports were more diversified. The importing countries in 2019 reached 63, and the top 5 countries only accounted for 54.02% of total exported rabbit meat in the global market. Diversified importing countries means more different languages, this ultimately caused the negative impacts on imports. In the general trade model, language variable is not significant. This may be attributed to the offset of positive effect on rabbit meat exports and the negative effect on imports.

WTO membership generally is not significant, except for the exporting country in the general trade model. This may be because that most trading countries have already been WTO members. The policies of rabbit meat trade in these countries are free and market-oriented and generally there is no protection from governments.

## CONCLUSIONS

In the past 60 years, the rabbit industry has achieved great progress globally. Before 2000, rabbit meat was mainly produced in Europe. In the past 20 years, rabbit meat production has moved largely to the Asia. In 2000, rabbit meat output in the Asia (428.66 thousand tonnes) firstly surpassed that of Europe (356.42 thousand tonnes). In 2019, Asia and Europe produced 81.75% and 12.11%, respectively, of global rabbit meat and the shares of Africa and Americans were 5.04% and 1.10%, respectively.

Different from production, the rabbit meat trade only increased for about 20 years from 1961 to 1979. After 1979, global rabbit meat trade fluctuated around 60 thousand tonnes for another 20 years. Since 2001 it has been stable at the level of 37 thousand tonnes with only small fluctuations. Increasing production while showing stable and decreasing trade indicates that rabbit meat is gradually consumed locally within countries. The trade pattern currently is from Asia (mainly China) and Europe (Spain, Belgium and France) to European countries. In 2019, the top 5 destinations were Germany, Belgium, Italy, France and Spain.

In regards to comparative advantage, Hungary is a strong competitor in the global market, while Spain and Belgium are gradually becoming two promising countries in rabbit meat trade. China was once a strong exporter, but in the past decade the domestic demand has increasing rapidly, while exports have been decreasing rapidly. France is a special case, which has been a key player in production, trade and consumption for about 50 years.

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 exports. As for production, countries with a higher population means lower labour costs and higher comparative advantages in rabbit meat production and exports. Common language and close borders denote similar traditions and dietary habits. It also affects trade significantly.

Based on above results, some suggestions and policy implications are provided : (1) Since rabbit meat is traded more locally or between neighboring countries, rabbit farmers or processing companies should pay more attention to domestic consumers or neighboring countries to exploit the market potential; (2) Experiences of France and Italy show that expanding multi-channels of exports can reduce risks and maintain a long-time stable position; therefore, traders should explore more markets so as to reduce trade concentration degree and avoid risks; (3) Population has significant negative effects on rabbit meat imports, which means the new generation consumes less rabbit meat. Governments should popularize the nutritional knowledge of rabbit meat to encourage people (especially young people) to consume more healthy rabbit meat, because this food can reduce obesity, as well as the risk of heart diseases and other serious diseases.

## ACKNOWLEDGEMENTS

This paper attempted to study global rabbit industry by focusing on trade, including trade development in the past 60 years, regional patterns and development, driving forces of trade, etc. Special thanks is given to president Thierry Gidenne and the Committee of 12th World Rabbit Congress. I would like express my sincere gratitude to Professor Luiz Carlos Machado for his very valuable comments and suggestions on the first draft. This research is partly funded by China Rabbit Research System (2011-2020). Also many thanks go to chief scientist Professor Yinghe Qin and my colleagues.

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