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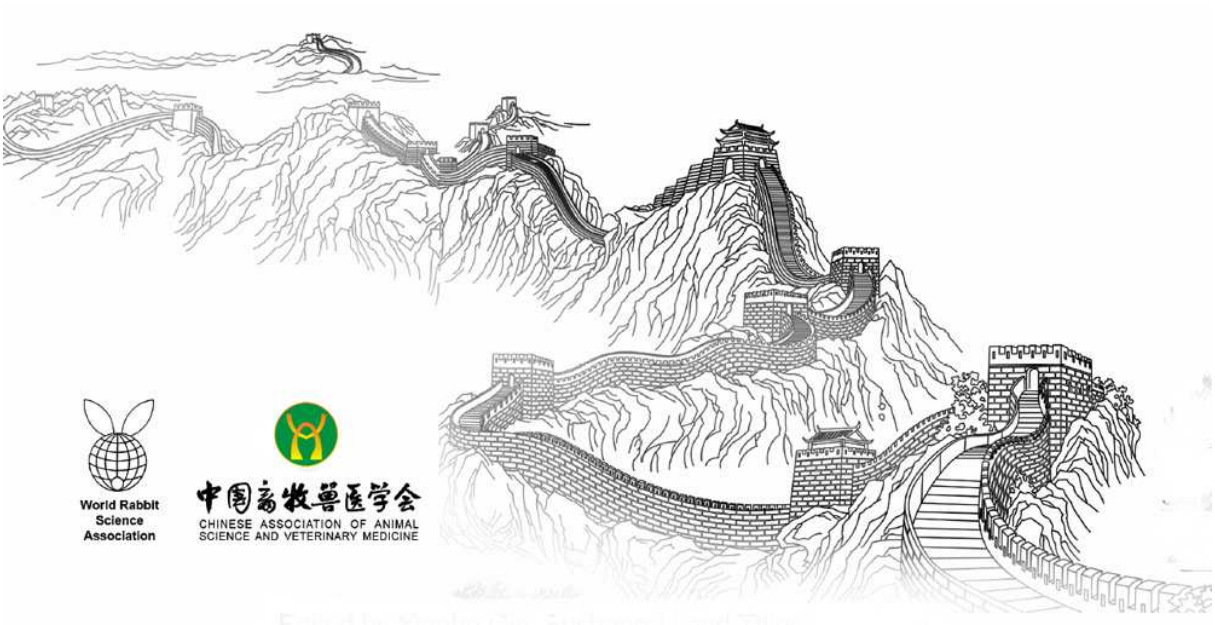

AN ANALYSIS OF THE SCALE EFFICIENCY OF MEAT RABBIT INDUSTRY

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ABSTRACT

This paper examines the scale efficiency of meat rabbit industry in China using a data from 2011 to 2015 and the DEA-Tobit model. Results show that meat rabbit breeding size and scale efficiency present an Invert-U curve relationship in China. Therefore, it is important to help operators on feeding rabbits in reaching the optimal size of breeding and enhancing the meat rabbits' supply capacity efficiently and effectively.

Key words: Scale efficiency, Breeding scale, Meat rabbit, DEA-Tobit model

INTRODUCTION

The size of farms on feeding rabbit used to very small in China, and traditionally rabbits were raised mainly in Southwestern and Eastern regions in China. However, during past five years more and more large- or medium-size farms have been emerging in north-western and central regions in China, and the production size in the rabbit feeding sector increased accordingly. The questions this study tries to answer are as follows: What is the scale efficiency in the sector about? Whether or not is the efficiency improved?

MATERIALS AND METHODS

Methods

The methods for measuring the production efficiency are composed mainly of parametric and nonparametric methods. The parametric methods include Shift-Share Method, econometric method and Stochastic Frontier Approach. This approach should specify a specific functional form and make some assumptions. Nonparametric methods include the index method and the data envelope analysis, which do not need to specify function form and to make assumptions on technology and market. While the index method needs assumptions such as neutral technological progress, constant returns to scale, and competitive market, DEA method does not need those assumptions.

DEA method has gradually become the main approach in measuring productivity and consequently, this study employs DEA method to measure meat rabbit breeding scale efficiency in China.

DEA mainly employs the linear programming method and observed sample data effectively, treat each unit as a Decision Making Units (DMU), and then evaluate the effectiveness of them. The results reflect the relative efficiency of each DMU.

Suppose the DEA model what we evaluate has *n* DMU, x_i and y_i represent the input and output of DMU_i. *X* and *Y* represent the matrix of input and output, then the comprehensive technical efficiency of DMU_i can be deduced from the following linear programming:

$$\begin{aligned} &Max \quad \lambda, \delta_i \\ &s.t. \quad -\delta_i y_i + Y\lambda \geq 0;\ x_i + X\lambda \geq 0;\ \lambda \geq 0 \end{aligned} \tag{1}$$

The pure technical efficiency of DMU_i can be obtained from the following linear programming:

$$\begin{aligned} &Max \quad \lambda, \delta_i \\ &s.t. \quad -\theta_i y_i + Y\lambda \geq 0;\ x_i + X\lambda \geq 0;\ \text{n1}'\lambda = 1;\ \lambda \geq 0 \end{aligned} \tag{2}$$

In the end, the scale efficiency of DMU_i can be calculate by the relationship of "scale efficiency = comprehensive technical efficiency divided by pure technical efficiency".

In order to study the relations between size and scale efficiency, we will also build Tobit-model to analyze the relationship between the breeding size and the scale efficiency of meat rabbit:

$$SE = \lambda_0 + \lambda_1 log(N) + \lambda_2 log(N)^2 + \lambda_3 log(N)^3 + \varepsilon \tag{3}$$

Where *SE* is the the scale efficiency of meat rabbit, *N* is the number of rabbit slaughtered, λ is a vector of unknown parameters, and ε is the random error. In equation (3), If λ_2 <0 and significant, it means that meat rabbit breeding size and scale efficiency present an Invert-U curve relationship; if λ_2 >0 and significant, it means that meat rabbit breeding size and scale efficiency present a U curve relationship.

Data and variables

The data used in this study come from a series of field surveys in Anhui, Beijing, Fujian, Hebei, Henan, Heilongjiang, Jilin, Jiangsu, Inner Mongolia, Shandong, Shanxi, Sichuan, Yunnan, Zhejiang and Chongqing(including municipalities and Autonomic Zones) during 2011- 2015. About 450 rabbit farmers were surveyed each year in the 15 provinces, which includes 162, 171, 197, 129 and 197 rabbit farms, respectively, from 2011 to 2015.Based on the breeding size classification for meat chicken and laying hens in The National Agricultural Cost-Benefit Data Collection compiled by the National Development and Reform Commission in China, this study classifies the farm types in terms of size into small-, medium-, and large-size farms. Table 1 reports the classification for the rabbit farms.

Table 1: The classification of farms in terms of size

Scale type	Small-size	Medium-size	Large-size
Number of rabbit slaughtered (*N*)	$N \leq 1000$	$1000 < N \leq 10000$	$N > 10000$

This paper takes *the gross output value of meat rabbits* as output variable, which includes the output value of main products and byproducts. The main products include commercial living rabbits and meat, the byproducts include sold male or female rabbits and material products (such as rabbit dung, offals and so on) and services (such as breeding, artificial insemination etc). The output value of main products and byproducts are monetary value, expressed in current prices.

Input variables includes *the cost of fodder, water, electricity and fuel power, health and epidemic prevention and technical services, labor force* and *depreciation of fixed assets*. (1)The cost of fodder including the cost of formula feed, green and coarse fodder, the processing of feed and other expenses; (2) The depreciation ratio of rabbit house building set as 8% and assuming it can be used for 20 years, the depreciation ratio of mechanical equipment set as 12.5% and the use age is 10 years; the depreciation ratio of other fixed assets set as 20%; (3) The cost of labor force including self-employed and hired labors. The variables of input mentioned above adopt the monetary statistics, expressed in current prices.

RESULTS AND DISCUSSION

Input-output Analysis of meat rabbits by different size

Figure 1 shows output, input and input-output ratio of meat rabbit in different size from 2011 to 2015. Firstly, from the view of total input, expend on each meat rabbit declines with the increase of the size. This reflects the economies of size and cost control ability with different size, that the larger the size, the stronger the control ability. Secondly, from the view of gross output value, the average output of meat rabbit in small breeding size is generally the lowest, followed by large breeding size and medium breeding size is the highest. But from the view of input-output ratio, it is obviously that the input-output ratio of small-size

is the lowest, the input-output ratio of medium-size raises substantially, and the input-output ratio of large-size is the highest. This conforms to the principle of economies of size.

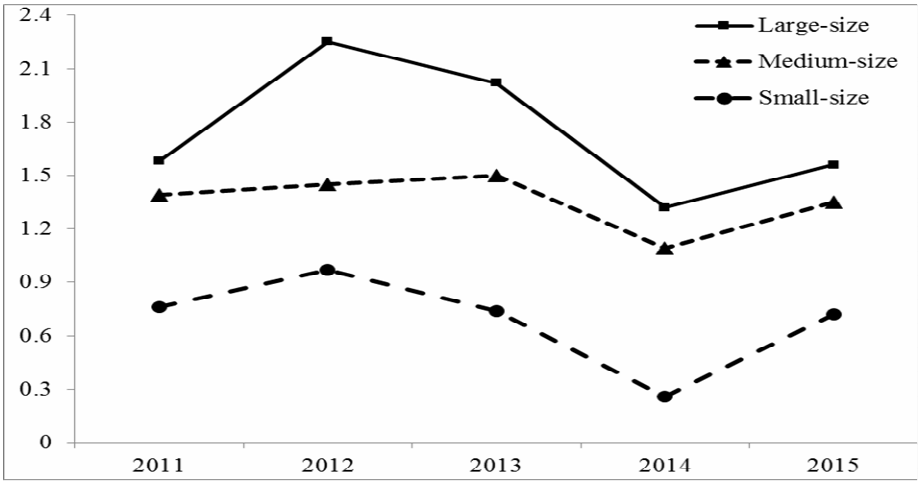

Figure 1: The trend of input-output ratio of meat rabbit in difference size

Breeding size and scale efficiency

Table 2 shows that the scale efficiency of meat rabbit in different size from 2011 to 2015. Generally speaking, the scale efficiency of large breeding size is the highest, and the small-size is the lowest.

Table 2: Scale efficiency of meat rabbit in different size

Year	Large-size	Medium-size	Small-size
2011	0.9436	0.9115	0.5523
2012	0.9706	0.8193	0.4920
2013	0.9626	0.8272	0.4432
2014	0.9536	0.8087	0.1220
2015	0.8006	0.9190	0.8949

Table 3 shows the regression of the model $SE=\lambda_1 \ln N+\lambda_2(\ln N)^2+\lambda_2(\ln N)^3+\varepsilon$, the result is: $SE=0.796949\ln N-0.06205(\ln N)^2+0.001521(\ln N)^3-2.29959$

Table 3: Estimated results of Tobit-model - Note: In order to compare the regional differences, we clarifies the sample farms based on the east-middle-west classification from the National Development and Reform Committee of China, the eastern regions includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Shandong, Guangdong, Hainan and Fujian; the central region includes Anhui, Henan, Heilongjiang, Jilin, Shanxi, Jiangxi, Hubei and Hunan; the western region includes Sichuan, Chongqing, Guizhou, Yunnan, Guangxi, Inner Mongolia, Shanxi, Gansu, Qinghai, Tibet, Ningxia and Xinjiang.

Variable	Coefficient	Standard error	t-statistics	P>|t|
Constant	-2.29959***	0.651148	-3.53	0.000
Log(N)	0.796949***	0.225677	3.53	0.000
$Log(N)^2$	-0.06205**	0.025734	-2.41	0.016
$Log(N)^3$	0.001521	0.000965	1.58	0.115
West	-0.01224	0.010962	-1.12	0.265
Middle	0.044792***	0.015489	2.89	0.004
2012	-0.04918***	0.015831	-3.11	0.002
2013	-0.07872***	0.014913	-5.28	0.000
2014	-0.04318**	0.017106	-2.52	0.012
2015	-0.06191***	0.015131	-4.09	0.000
σ	0.137312***	0.003523	38.97	0.000

***, ** and * represent the significance in the level of 1%, 5% and 10% respectively.

CONCLUSIONS

This study examines scale efficiency in the rabbit feeding sector. Results show that the relationship between the farm size and scale efficiency in the rabbit feeding sector in China presents an invert-U curve relationship, suggesting that neither larger farms nor smaller farms are efficient. Moreover, results show that the scale efficiency differs among regions, breeding methods, and breeding technologies used. Hence, it is necessary to strengthen the guidance and management of meat rabbit breeding size. In addition, results suggest that the medium-size breeding farms are helpful in decreasing the cost of feeding meat rabbits and accordingly improving the profits.

ACKNOWLEDGEMENTS

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REFERENCES

Chen Nian-hong and Cao Jian. (2010). Analysis of the technical efficiency of different scale dairy cultivation in China. *Journal of Hunan Agricultural University (Natural Sciences), 36(1): 54-57.*

Yan Zhen-yu and Xu Jia-peng. (2012). Is Scale Production of Live Pig More Efficient? As well as the Choice of Moderate Scale of Pig -raising in Different Areas of China, *Collected Essays on Finance and Economics, 2: 3-7.*

Zhao Yi-fu and Qin Fu. (2015). Analysis on the layer breeding scale efficiency and its influencing factors. *Journal of China Agricultural University, 20(3), 291-298.*

Zhang Dong-ping and Feng Ji-hong. (2005). Data Envelopment Analysis of the Efficiency of Wheat Production in Henan Province. *Journal of Henan Agricultural University, 3: 48-54.*

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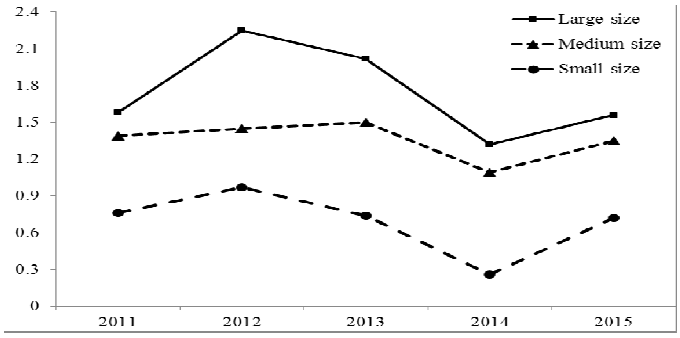

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