Operation Efficiency and Influencing Factors of Listed Companies of Swine Industry: Empirical Analysis Based on Data of 16 Listed Companies in 2010 - 2014

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Abstract Listed companies of the swine industry, as an important form of agricultural industrialized operation, are typical representatives of large-scale production and the level of their operation efficiency exerts a direct influence on the healthy development of the swine industry. Using the DEA-based Malmquist method, this paper made a static and dynamic evaluation of the operation efficiency of 16 listed companies in China's swine industry in 2010 - 2014. It obtained following results: (i) The overall efficiency of listed companies of China's swine industry remained at high level and the development trend was excellent. (ii) Different types of enterprises had difference in the overall efficiency, pure technical efficiency and scale efficiency. In general, pig feed processing companies had the best performance, followed by slaughtering and deep processing companies, and swine breeding companies were the worst. (iii) The total factor productivity characterized by the Malmquist index declined year by year in 2010 - 2013 and was improved in 2014, mainly due to technological progress. (iv) The total asset turnover ratio, equity concentration, and R & D management level had a significantly positive impact on the operation efficiency of listed companies in the swine industry, while the human capital had a significantly negative impact.

Key words Operation efficiency, Influencing factor, Listed companies of swine industry, DEA-based Malmquist, DEA-Tobit

1 Introduction

The swine industry is an important pillar industry concerning the people's livelihood. However, in recent years, China's swine industry faces huge pressure from both domestic and foreign areas. In domestic side, environmental protection and food safety become new requirements for the development of the industry[1], manure treatment, breeding land and disease prevention and control are difficult problems urgently to be solved; in foreign side, the integrated competitiveness still has a big gap with developed countries. The breeding cost in China is 40% higher than that in the United States. The weight increase per kilogram consumes 0.5 kg feed more than in the EU. The annual supply of commercial pig is 8 - 10 heads less than in advanced countries. In April 2016, the *Production Development Plan for National Swine Industry* (2016 - 2020) set forth the objective of "keeping stable growth of production and scale proportion" and the requirements of "leading enterprises driving and industrial integration". The complete swine industry chain refers to the process of all aspects with upstream and downstream relations and closely related to the pig products[2], including (from top to bottom) pig feed industry, swine breeding, slaughtering and meat product processing, pork wholesale and retail, and consumers. Through literature review, studies of the efficiency of swine industry are concentrated on following three aspects. (i) The studies of operation efficiency and its decomposition. Nigel *et al.*[3] analyzed the growth of swine production in the United States and found that the total factor productivity of swine production increased by 109.1% in 1992 - 2004, in which the scale efficiency and technological progress were the core forces[3]. Based on the financial statement, domestic reports demonstrated and analyzed the business performance of China's swine breeding enterprises in the first half of 2015. (ii) Studies about different regions or scales. Nigel Key and William McBride, taking different scale of swine breeding farms as research object, pointed out that the increase in the scale will bring about drop of total cost of production, but many small and medium-sized swine breeding farms have higher competitive advantages in production management cost[5]. Wang Mingli and Li Weiyi calculated the technical efficiency of the main swine production areas in China using SFA method, and discussed the regional differences and the output elasticity of the input factors[6]. Tan Ying compared the regional differences of China's swine production efficiency and its decomposition using DEA method[7]. (iii) Other studies. Ma *et al.*, using the logarithmic cost function, analyzed China's swine production adjustment data, and stated that the technological progress of swine production is non-neutral and there exists substitution relationship between input elements[8]. Based on the study on the cost and income data of scattered swine breeding farmers in 1995 - 2009, Yu Wen *et al.* put forward an effective method for increasing the output efficiency[9]. It can be found that most of the researches only discussed the input-output efficiency, but did not consider the efficiency influencing factors.

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2 Study methods and analysis tools

2.1 DEA-based model-input type BCC model Swine industry is a special entity production activity. It reflects all aspects of the entire industry chain. It is characterized by many input factors and complex production and operation activities. Using the DEA method to evaluate the operation efficiency of swine enterprises, it is not necessary to determine the basic production function and estimate the function parameter coefficient[10], so it can greatly simplify the process and solve the problem of different dimension of indicators. In this study, we selected the input type BCC model to reflect the increase and decrease of the returns to scale, and measure the overall efficiency, pure technical efficiency and scale efficiency. Assuming there are n decision-making units (DMU), each decision-making unit has m inputs, s outputs, the input and output of decision-making unit in the system can be expressed as[11]:

$$x_j = (x_{lj},\ x_{2j},\ K,\ x_{mj})^T,\ j = 1,2,K,n,$$
$$y_j = (y_{lj}, yx_{2j},\ K,\ y_{sj})^T,\ j = 1,2,K,n,$$
$$v = (v_1,\ v_2,\ K,\ v_m)^T,$$
$$u = (u_v,\ u_2,\ K,\ u_m)^T.$$

where x_{ij} is the i-th input of the j-th DMU; y_{rj} is the r-th output of the j-th DMU; v_i is the measure of the i-th input; u_r is the measure of the r-th output, $i = 1,2,K,s, j = 1,2,K,n$. Then, BCC model can be expressed as follows[9]:

$$(P_{\mathrm{BCC}}) \begin{cases} max(\mu^T y_{j0} + \mu_0) = V_p, \\ s.t.\ \omega^T x_j - \mu^T y_j - \mu_0 \geqslant 0, j = 1,2,K,n, \\ \omega^T x_{j0} = 1, \\ \omega \geqslant 0,\ u \geqslant 0. \end{cases}$$

where $t = \dfrac{1}{v^T x_{j0}}$, $w = tv$, $\mu = tu$. The efficiency is in the range of 0 to 1, the closer to 1, the higher the efficiency. The relationship of related efficiency is: overall efficiency = pure technical efficiency × scale efficiency.

2.2 DEA-based Malmquist index model In order to further analyze the changes in the operation efficiency of the listed companies in the swine industry and make clear the reasons for the change, we studied the dynamic changes of the productivity of the sample enterprises by DEA-based Malmquist index model. From the period t to $t+1$, the input-oriented Malmquist index can be expressed as follows:

$$M_c^{t,t+1} = \frac{D_c^{t+1}(x^{t+1}, y^{t+1})}{D_c^t(x^t, y^t)} \times \left[\frac{D_v^t(x^t, y^t)}{D_c^t(x^t, y^t)} \times \frac{D_c^{t+1}(x^{t+1}, y^{t+1})}{D_v^{t+1}(x^{t+1}, y^{t+1})} \right] \times \left[\frac{D_c^t(x^t, y^t)}{D_c^{t+1}(x^t, y^t)} \times \frac{D_c^t(x^{t+1}, y^{t+1})}{D_c^{t+1}(x^{t+1}, y^{t+1})} \right]^{1/2}$$

where the first part and second part denote the pure technical efficiency and scale efficiency separately, and the third part denotes technological progress. The Malmquist index can be decomposed into the overall technical efficiency change index (TEC) and the technological progress index (TC) which reflects the progress of technology and represents the movement of the efficiency frontier. Under the premise of returns to scale not changed, the overall technical efficiency change index (TEC) can be further decomposed into the scale efficiency change index (SEC) and the pure technical efficiency change index (PTEC), namely, Malmquist index = TEC × TC = PTEC × SEC × TC.

When the Malmquist index > 1, the operation efficiency will increase; otherwise, it will decline; when the Malmquist index = 1, the operation efficiency will keep unchanged. If the rest decomposition index is > 1, the operation efficiency is improved; if it is < 1, the efficiency is decreased.

2.3 DEA-Tobit two-step method In this study, we used DEA-Tobit two-step method to analyze factors influencing the operation efficiency of listed companies in the swine industry. In the past, researches about the efficiency influencing factors often used the ordinary least squares (OLS). However, the efficiency is in the range of 0 to 1, so there is problem of data deletion and loss and the parameters estimated by OLS method may be inconsistent. Using DEA-Tobit two-step method, we can solve the above problems. We took DEA overall efficiency of samples as dependent variable and various influencing factors as independent variables, and used Tobit model to explore the influence degree of each variable on the operation efficiency. The corresponding Tobit regression model can be expressed as follows:

$$TE_{jt} = C + \alpha_1 x_{1jt} + \alpha_2 x_{2jt} + \cdots + \alpha_n x_{njt} + \mu_{jt}$$

where TE is dependent variable and denotes DEA operation efficiency, C is constant term, $x_i (i = 1,2,\cdots. n)$ is explained variable, $a_i (i = 1,2,\cdots. n)$ is the regression coefficient of explanatory variable, μ denotes residual term, j is the number of listed companies, t is the period, and n is the number of explained variables.

3 Evaluation of operation efficiency of listed companies in the swine industry

3.1 Indicator selection and data source

3.1.1 Indicator selection. When evaluating the operation efficiency of an enterprise by DEA method, the key is the indicator selection. Existing researches[12-15] selected the input indicators mainly from the labor input, cost, and capital investment and selected output indicators from the profitability, operation income and other aspects. With reference to the existing findings, combining the DEA indicator selection principle and China's swine industry characteristics, we built the following input-output indicator system.

3.1.2 Sample selection and data source. According to DEA decision making unit selection principle, we selected 16 companies listed in Shanghai and Shenzhen Stock Exchanges. 5 enterprises mainly deal with swine breeding (Truein Group, Dakang Farming, Luoniushan, New Wellful, and Muyuan Food); 6 enterprises mainly deal with swine feed processing (Dabeinong Group, Zhengbang Group, TRS Group, New Hope Group, Zhenghong Group, and Jinxinnong Technology); 5 enterprises mainly deal with swine slaughtering and deep processing (Shunxin Agriculture Company, Shuanghui, Shanghai Meilin, Delisi, and Guanghong

Holdings). The study period is 2010 – 2014. The selected enterprises cover all listed swine companies in the sample period, so they are representative. Important information and related indicators come from the annual information disclosure and reporting, the main source sites include: Sina Finance Network, Juchao information network, Stock Star network, and the Finance online.

Table 1 The input-output indicator system of listed companies in the swine industry

Indicator code	Indicator name	Description and unit
Input indicator 1	Total assets	Sediment of capital input by the enterprise for business activities, reflecting the size of enterprise and condition of assets (Unit: 10^4 yuan)
Input indicator 2	Operation cost	Direct costs incurred by the enterprise in producing or selling products or services related to the main business (Unit: 10^4 yuan)
Input indicator 3	Fees	Sum of current year sales costs, management fees, and financial costs (Unit: 10^4 yuan)
Input indicator 4	Number of employees	Reflecting the intensity of labor input, calculated at the total number of employees in the annual report statistics (Unit: 10^4 yuan)
Output indicator 1	Operation income	Relative to the operation cost in the input indicator, reflecting the profitability and growth ability of enterprise (Unit: 10^4 yuan)
Output indicator 2	Liquidity ratio	Ratio of current assets to current liabilities, reflecting the operation ability of enterprise (Unit: 10^4 yuan)
Output indicator 3	Fixed assets turnover	Ratio of sales income to net fixed assets, reflecting the debt – paying ability and capital structure of the enterprise (Unit: 10^4 yuan)

3.2 DEA static analysis

3.2.1 Overall analysis of industrial efficiency. BCC model can decompose the overall technical efficiency into pure technical efficiency and scale efficiency. Pure technical efficiency reflects the output ability of an enterprise under the current conditions and reflects the management level of decision makers, while scale efficiency reflects whether an enterprise is producing under fixed-scale returns[16]. According to calculation results of EDAP2.1 software, we arranged the mean value of the overall efficiency, pure technical efficiency and scale efficiency of the sample companies in 2010 – 2014.

Table 2 Mean value of DEA efficiency in 2010 – 2014

DEA efficiency	2010	2011	2012	2013	2014
Overall efficiency	0.953	0.961	0.976	0.988	0.955
Pure technical efficiency	0.957	0.973	0.994	0.998	0.987
Scale efficiency	0.996	0.988	0.982	0.990	0.966

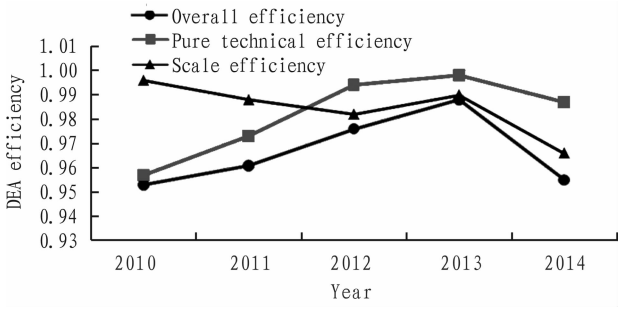

Fig. 1 Curve lines for mean value of DEA efficiency in 2010 – 2014

On the whole, in the sample period, the overall efficiency of listed companies in the swine industry was high and fluctuated in 0.95 – 0.99; in 2010 – 2013, it continuously rose. In 2014, it started to decline. Further analysis shows that the changes in pure technical efficiency was consistent with that in the overall efficiency, which means that the level of resource utilization and management of sample companies was increasing in 2010 – 2013, and the same output can be obtained by investing less resources under existing conditions of technology and resources. In 2014, the efficiency declined possibly because of the rise of feed cost. In 2010 – 2012, the scale efficiency constantly declined. According to the actual situation, China released large-scale breeding support policy. Since 2007, the central government annually allocated 2.5 billion yuan for special support. By 2010, the scale production of swine enterprises became saturated, and the promotion function of policy gradually disappeared; in 2013, benefited from the incentive policy of government for the pig counties, the central government arranged 3.5 billion yuan of incentive funds for the development of swine industry, and the returns to scale of swine enterprises got increasing. In sum, the high mean value of overall efficiency is closely connected with high pure technical efficiency and scale efficiency, but the trend of changes is mainly affected by the pure technical efficiency.

Table 3 Comparative analysis of DEA efficiency of listed companies in 2010 – 2014

Type of listed companies	Mean value of overall efficiency	Mean value of pure technical efficiency	Mean value of scale efficiency
Swine breeding companies	0.937	0.972	0.965
Slaughtering and deep processing companies	0.973	0.981	0.991
Pig feed processing companies	0.986	0.991	0.995

3.2.2 Comparative analysis of the industry segmentation. Listed companies in this study mainly include swine breeding companies, slaughtering and deep processing companies, and feed processing companies. According to calculation results of DEAP2.1 software, we obtained the mean value of each efficiency, as shown in Table 3 and Fig. 2.

Overall, no matter in the overall efficiency, or the pure technical efficiency or the scale efficiency, pig feed processing companies were the highest in 2010 – 2014, followed by slaughtering and deep processing companies, and the lowest were swine breeding companies. Combined with the actual situation analysis, for the pure technical efficiency, the pig feed processing companies had the highest overall level possibly because China's large and medium-sized pig feed processing enterprises had advanced production research and development technologies, and they attached importance to the application of new technologies, making they had high competitive advantages in feed sales, raw material purchase and industrial chain extension[16]. For the scale efficiency, swine breeding companies had the lowest scale efficiency, possibly because of the difficulty in manure treatment and disease prevention and control.

3.3 Dynamic analysis of Malmquist index We used DEA-Malmquist model to reflect dynamic changes in the operation efficiency of listed companies of swine industry. We calculated the Malmquist index and mean values using DEAP 2.1 software. The calculation results are listed in Table 4.

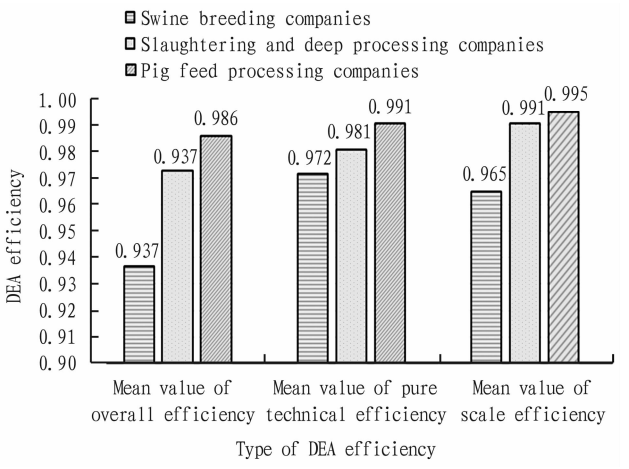

Fig. 2 Block diagram for DEA efficiency of listed companies in 2010 – 2014

Table 4 Malmquist index and decomposition mean values of listed companies

Year	Technical efficiency change index EFFCH	Technological progress index TECH	Pure technical efficiency change index PECH	Scale efficiency change index SECH	Malmquist index TFPCH
2011 – 2010	1.008	0.964	1.016	0.992	0.972
2012 – 2011	1.016	0.875	1.023	0.993	0.889
2013 – 2012	1.013	0.920	1.005	1.009	0.932
2014 – 2013	0.963	1.081	0.989	0.974	1.041
2010 – 2014	1.000	0.957	1.008	0.992	0.957

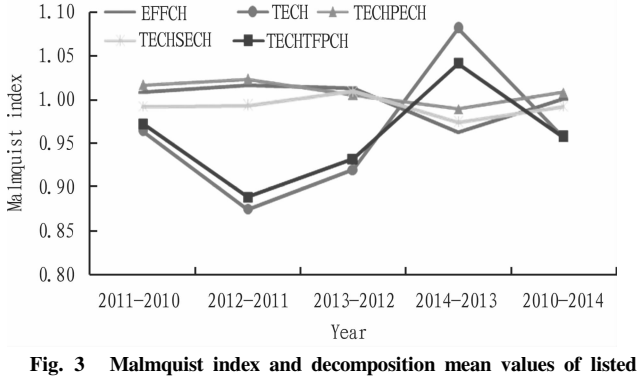

Fig. 3 Malmquist index and decomposition mean values of listed companies

For the overall trend, in 2010 – 2014, the Malmquist index took on "V" shape. The changes in technological progress index were consistent with it, while other efficiency change index was relatively steady. It indicates that the changes in the productivity of China's swine enterprises were mainly due to technological progress. In addition, in the sample period, the mean values of Malmquist index and technological progress index were 0.957, indicating that both the operation efficiency of sample enterprises and industrial technology dropped at annual rate of 4.3%, further proving that technological decline leads to drop of the total factor productivity. Besides, in 2012 – 2011, the Malmquist index reached the bottom (0.889) of the V shape, indicating that compared with the year 2011, the production efficiency of swine enterprises slightly dropped in 2012. For the Malmquist index and its decomposition, except in 2014 – 2013, Malmquist index was lower than 1 in the rest years, indicating that the total factor productivity gradually declined in 2010 – 2013 and started rising in 2014. Changes in the technological progress index was consistent with the Malmquist index, reflecting the production technologies were declining in 2010 – 2013, and made progress in 2014, possibly benefited from fine variety introduction of central government and financial support for manure treatment technologies in 2013 – 2014. For the technical efficiency change index, except lower than 1 in 2014 – 2013, it was greater than 1 in the rest years, indicating that the technical efficiency of listed companies in China's swine industry took on a growing state, had excellent capital utilization and management level. But it declined in 2014. The pure technical efficiency index and scale efficiency change index of these listed companies were 0.989 and 0.974, less than 1 in 2014 – 2013, indicating that their decline led to the drop of technical efficiency.

4 Analysis of influencing factors

4.1 Variable selection and hypothesis Based on the existing

literature[17-21] and actual background, we designed and selected following seven variables to analyze factors influencing the operation efficiency of listed companies in the swine industry. Specific description and expected direction of variables are listed in Table 5.

Table 5 Factors influencing the operation efficiency of listed companies in the swine industry

Name of variable	Explanation of variable	Symbol of variable	Expected direction
Years of establishment	The first year of establishment is 0, and add 1 for one year	YEAR	+
Company scale	Logarithm of total assets	SCAL	+
Human capital	Percentage of workers with college or above level to total workers	RLZB	+
Turnover of total assets	Percentage of income of man business to average total assets	ZCZZ	+
Equity concentration	Percentage of shares of three largest shareholders to total shares	GQJZ	+
Asset-liability ratio	Percentage of total liability to total assets	ZCFZ	–
R&D and management level	Percentage of intangible assets to total assets	YFGL	+

Generally, the longer years of establishment (YEAR) means the more management and technical experience, more favorable for improving efficiency[18]. With the increase in production scale of swine industry in China in recent years, the swine industry is expected to realize scale economy. Thus, the expansion of enterprise scale (SCAL) will bring about the reduction of unit production costs, and thus bring about the increase of operation efficiency. According to the existing researches[19], the higher the educational level of the staff, the higher the overall competitive strength, the more favorable for improving the efficiency of enterprises, so we believed that human capital (RLZB) will have a significantly positive effect on the operation efficiency. The total asset turnover (ZCZZ) reflects the level of operation capacity of the listed companies. Du Chuanzhong[17] stated that the relatively high total asset turnover rate can make the company maintain a good operation state, so it is believed that the total asset turnover rate has a positive effect on the operation efficiency of enterprises. Since the swine industry is a high input industry, the five largest shareholders hold more shares, they will have greater power in decision making, and the operation efficiency will be higher. In other words, the equity concentration (GQJZ) will exert a positive influence on the operation efficiency. The study of Gao Zhigang[18] indicates that the higher asset-liability ratio (ZCFZ) negatively affects its technical efficiency, so we believed that asset-liability ratio has a significantly negative effect on the operation efficiency of listed companies in the swine industry. Finally, R & D and management level (YFGL) is the powerful support for technological innovation ability of enterprises, higher technological innovation level is more favorable for increasing the operation efficiency of enterprises.

Substituting the above variables into Tobit regression model, we obtained following equation:

$$TE_{jt} = C + \alpha_1 YEAR_{jt} + \alpha_2 SCAL_{jt} + \alpha_3 BLZR_{jt} + \alpha_4 ZCZZ_{jt} + \alpha_5 CQZJ_{jt} + \alpha_6 ZCFZ_{jt} + \alpha_7 YFGL_{jt} + \mu_{jt}$$

4.2 Analysis on empirical results Using Eviews 6.0 software, we made Tobit regression analysis on the overall efficiency on listed companies of the swine industry, as listed in Table 6.

Table 6 Regression results of Tobit model

Explanatory variable	Regression coefficient	Standard deviation	Z statistic	Concomitant probability
Constant term (C)	0.927480	0.198977	4.661251	0.0000
YEAR	-0.001642	0.001384	-1.186366	0.2355
SCAL	-0.016798	0.032678	-0.514060	0.6072
RLZB	-0.003865	0.001083	-3.568082	0.0004***
ZCZZ	0.059526	0.013976	4.259264	0.0000***
GQJZ	0.000864	0.000657	2.314306	0.0189**
ZCFZ	0.000676	0.000775	0.872910	0.3827
YFGL	1.825937	0.579576	3.150471	0.0016***

Note: *** and ** signify 1% and 5% significance level respectively.

From Table 6, it can be known that RLZB, ZCZZ, GQJZ, and YFGL passed Z test and had significant influence on the overall efficiency, while YEAR, SCAL, and ZCFZ did not pass Z test. The regression coefficient of YEAR, SCAL and RLZB was negative, while that of other 4 variables was positive. (i) RLZB negatively influenced the operation efficiency of swine enterprises at 1% significance level, which is inconsistent with the expectation. This is possibly because although swine industry is changing to intensive and large scale production in recent years, it still belongs to labor intensive industry with extensive production, and swine enterprises have limited demands for talents with high educational level. (ii) ZCZZ positively influenced the operation efficiency of swine enterprises at 1% significance level, which is consistent with the expectation. The production cycle of listed companies in the swine industry is generally short, the turnover efficiency of pigs and pork to a large extent affects the operation efficiency. Strong market discrimination and marketing ability is the fundamental point to ensure that the survival rate of swine enterprises, so the timely sale of products, reduction of inventory, and acceleration of product turnover are the key to increasing the operation efficiency. (iii) GQJZ had positive influence on the operation efficiency of swine enterprises at 5% significance level, which is

consistent with the expectation. For the swine industry, because swine enterprises, especially swine breeding and pig feed processing companies have to make huge investment in the early stage, they need strong shareholders to support, and the moderate concentration of equity can better solve this problem, and it is favorable for increasing the overall competitiveness of enterprises, so as to increase the operation efficiency. (iv) YFGL had positive influence on the operation efficiency of swine enterprises at 1% significance level, which is consistent with the expectation. Proper increase in R & D investment can effectively reduce the cost of production and improve product quality, which has positive effect on the operation efficiency of enterprises. For example, for raw materials with high consumption, swine enterprises can adopt "soybean meal + wheat" or "corn + soybean meal" and other formula to reduce feed production costs, or increase R & D investment in the development of new feed products for food substitutes, which is favorable for opening the market and increasing benefits of enterprises.

5 Conclusions and recommendations

5.1 Conclusions (i) The overall efficiency of listed companies of China's swine industry remained at high level and the development trend was excellent, and the high mean value of overall efficiency was closely connected with high pure technical efficiency and scale efficiency. (ii) Different types of enterprises had difference in the overall efficiency, pure technical efficiency and scale efficiency. In general, pig feed processing companies had the best performance, followed by slaughtering and deep processing companies, and swine breeding companies were the worst. (iii) The total factor productivity characterized by the Malmquist index declined year by year in 2010 – 2013 and was improved in 2014, mainly due to technological progress. Changes in Malmquist index in China's swine enterprises depended mainly on technological progress, while the fluctuation of technical efficiency change index, pure technical efficiency change index and scale efficiency change index was relatively stable. (iv) The total asset turnover ratio, equity concentration, and R & D management level had a significantly positive impact on the operation efficiency of listed companies in the swine industry, while the human capital had a significantly negative impact. The influence of years of establishment, company scale, and asset-liability ratio was not significant on the operation efficiency of swine companies.

5.2 Recommendations (i) It is recommended to energetically promote large scale operation and cultivate enterprises to get listed. All areas should develop scientific cultivation plan, invite investment in the scope of the plan, guide and introduce high quality enterprises with high competitiveness, standardized operation, and high efficiency, especially the local leading enterprises. In addition, it is recommended to implement policies for encouraging enterprises to get listed and help enterprises in reducing burdens of getting listed. (ii) It is recommended to provide persistent policy support for swine breeding enterprises. In the swine industry, the operation efficiency of the swine breeding companies is lower than that of the pig feed processing companies and the slaughtering and deep processing companies. The government may consider formulating proper policies for support of swine breeding enterprises, such as some policy and financial support for the export of their products. (iii) It is recommended to attach great importance to advanced production technologies and increase input in research and development. Swine enterprises should pay attention to the improvement of advanced technologies, the introduction of advanced equipment and scientific management methods, in order to reduce costs and improve product quality. Besides, they should communicate with colleges and universities and other enterprises to realize technical cooperation. (iv) It is recommended to review the operation situations in an all-round manner and increase the operation efficiency. Apart from the R & D and management level, human capital, total asset turnover and equity concentration are also significant factors influencing the operation efficiency of listed companies in the swine industry. Enterprises should strengthen the forecast of talent demands, formulate a reasonable training program, and pay attention to increasing the per capita output value and reducing the per capita management fee in the course of business activities. For the concentration of equity, the equity in current swine industry is relatively decentralized, the overall concentration is low, thus managers may consider increasing the shareholding proportion of large shareholders through stimulating their investment enthusiasm.

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City is further expanded. In 2014, the per capita net income of rural residents in Motuo County is only 0.57 of Nyingchi County, and the gap is still expanding.

4.2 Recommendations From the conclusions of this study, wage income and household operating income, agricultural income gap constitutes the main parts of the per capita net income gap of rural residents in Nyingchi City. Zhang Jiansheng (2012) also obtained similar conclusions from the study on the per capita net income of rural residents in China[5]. Therefore, we came up with following recommendations for the reference of decision making of government and related departments.

4.2.1 Promoting reasonable flow of labor forces. To fundamentally change the situation of unequal income distribution of the rural residents, the government must take measures from wage income, household operating income, and agricultural income. On the one hand, it is recommended to promote the transfer of rural labor forces to the secondary and tertiary industries, strengthen the effort of eliminating mechanism obstacles of rural surplus labor transfer and accelerate reasonable flow of labor forces. Rural labor transfer is an effective measure for accelerating the rural industrial structure and promoting urban and rural development, and also the most direct and effective measure for increasing income of farmers and herdsmen[6]. The local government should formulate policies of stimulating rural labor transfer and increasing wage income and transfer income of rural residents. In addition, relying on agricultural leading enterprises, it is recommended to expand channels of rural labor force employment, and attract some farmers and herdsmen relying on agricultural ecotourism and catering.

4.2.2 Speeding up the construction of small towns in rural areas, and promoting the establishment of rural cooperatives. It is recommended to concentrate family experience in the township enterprises, rural cooperatives, speed up the rural land circulation, and promote large-scale and industrialized operation of agriculture. Besides, it is recommended to accelerate the establishment of modern agricultural production system, adjust planting and breeding structure relying on agriculture, forestry, animal husbandry and fishery, increase the yield per mu, guide farmers and herdsmen, plant high yield crops, breed aquatic products and livestock with market benefits, and increase the income of farmers and herdsmen.

4.2.3 Increasing the proportion of the tertiary industry and promoting integrated development of agriculture and eco-tourism. It is recommended to promote modern agricultural sightseeing, ecotourism, and agritainment, to expand diversified production income of farmers. Besides, it is recommended to strengthen preferential policies for benefiting farmers and promoting tourism development, implement strategies of benefiting farmers and strengthening tourism, to provide loose environment for agricultural industrialized development and rapid tourism development. Finally, it is recommended to further increase investment in transportation, wholesale and retail trade, catering, and social service industries, and support the development of rural e-commerce, convenience store, supermarket, catering, and rural endowment from funds, talents, and technologies.

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