The Research on Logistics Efficiency and Otherness on Primary Zone of Jilin Province

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Abstract. Logistics efficiency is a very important index for measuring the development quality of logistics industry and even region economies. In this paper, the index system upon the logistics efficiency of primary zone of Jilin province were constructed and the logistics efficiency were calculated by Malmquist-Dea Model. The result showed that the logistics efficiency had been generally declining in recent year, the logistics efficiency overall level is not high and the region differences still exist. The results also indicated that the scale efficiency change can promote total factor productivity (TFP) but the technology change hinder the development of TFP.

1. Introduction

Logistics refers to the flow process of goods from suppliers to receivers, which organically includes transportation, storage, load and unload, packaging, distribution, information control. logistics has become the third profit sources fountainhead, which had been proved to be the most generally affecting factors and has shown powerful scale economy and creativity. Internationally, logistics is generally claimed to be the basis support conditions and driving forces of national economy, which play a key role in economic growth and has critically important strategic position. According relevant research, the increase of 2% in will enable region economies to increase by 1%. So the logistics have ties with region economies, they are sharing mutual promotion and common development [1].

Jilin province situated in the central part of northeast China, which also located in the geometric central zone made up Russia, Korea, South Korea, Mongolia and northeast of China. Jilin province borders Heilongjiang province to the north, Liaoning province to the south, Mongolia autonomous region to the west, Russian federation to the east, face each other across the river with Korea to the southeast.

Logistics rapid development of Jilin province play an important role on foreign economy cooperation of Jilin and Northeast China, raising level and quality of Jilin province opening-up So it could promote Jilin province logistics development, strengthen the directivity of financial support and accelerate logistics management reform through researching on otherness of main zone in Jilin province, analyzing on key factors which stunting logistics efficiency and reason mentioned above. That will play an important role in transform development mode, adjusting and optimizing industrial structure, promoting scale and level of modern services and raising regional competitiveness of Jilin province [2].
2. Literature Reviews

Major progress of Research on logistics efficiency has been made so far and relevant literature focused mainly on theoretic and empirical studies. But there was only little literature on logistics efficiency and otherness of Jilin province. Li Min (2009) considered, based on the plan upon modern logistics adjustment and revitalization of China government, modern logistics system and logistics industries are very important for advancing logistics efficiency. And The successful development of logistics is the critical factors for other industries sustainable development [3]. Ying, Fei, Tookey (2014) analysed detailed factors stunting logistics construction through analyzing construction logistics. By data analysis, the main reason caused low efficiency of logistics efficiency was the low level of supply chain management and skill operation, and improving supply chain management is the important approach to promote logistics efficiency. All measures should be formulated based on improving supply chain management [4]. Eleonora Bottani, Antonio Rizzi(2015) took logistics supply chain management for research objects, proposed an integration method to improving logistics sustainability and efficiency. The results shown that the integration activity of packaging, transportation, warehousing and purchasing can improve logistics efficiency and resource utilization rate significantly [5]. Teodor Gabriel Crainic, Benoit Montreuil(2016) pointed out the combination of logistics with physical network can freight status, improve logistics efficiency, increase economic output and maintain sustainable development of environment and society. They also indicated the key to improve city logistics efficiency is to combine the last physical network with transport networks and build high efficiency and sustainable city logistics and transport system [6]. Chun-hua Ju, Changbing Jiang (2012) studied the efficiency of logistics network infrastructure by DEA-PCA method and analyzing 25 cities logistics infrastructure efficiency in the pear river delta of China by principle component analysis (PCA) and DEA methods [7]. Jihong Chen, Zheng Wan(2016) obtained 6 comprehensive index on efficiency of port logistics and analyzed the efficiency of port logistics by DEA. The results shown that efficiency of port logistics can be analyzed effectively using DEA-PCA methods and pointed out that operational efficiency of port presented directly the port synthesis competition [8]. Tian yu (2000) defined the logistics efficiency as resource input-output ratio, which can be measured by cost, hour and quality and etc. He pointed out that DEA can accurately analyze logistics efficiency for it can deal with systematic multiple input and output matters [9]. He li-ming (2015) deemed that the logistics development must focus on improving the level of logistics services experience and service ability. And the departments should improve whole logistics efficiency through new information technology, such as big data, cloud computing, internet of thing and mobile internet [10]. Gao mu-jing (2012) constructed the mutil-input and mutil-output evaluating logistics index, shown up that the inefficient DUM of Sanxi province and the adjustment quantity inefficient DMU were ensured by utilizing the project analysis on DEA efficient frontier. Based on results mentioned above, the suggestion on improving Sanxi logistics efficiency had been proposed through economy&police, logistics infrastructure, logistics technology innovation, logistics association and logistics linkage mechanism. Liu yun-feng, Song kai-jie (2014) proposed recommendation for making Beijing logistics, aimed at environment and economy objects, quickly and effectively develop by utilizing DEA model.

In summary, domestic and oversea scholars have taken up large-scale research on logistics efficiency. But in retrieval scope, research aimed at regional logistics efficiency and otherness of Jilin province had not been found. So this paper analyzed the major region and whole logistics efficiency of Jilin province from 2010-2017 and proposed related suggestion on improving Jilin logistics efficiency.

3. Indicators and Methodology

3.1. Input-output Indicators

At present, uniform standard on logistics efficiency had not been formed due to complexity and uncertain of logistics. According to cobb-douglas production function, input elements include capital, labor and technology. Owning to technology is difficult to obtain and quantify, capital and labor were introduced as input indicator for evaluating logistics efficiency of Jilin province in this
According to statistical yearbook of Jilin province etc. and data availability, input indicators included fixed capital investment and employment of Jilin province. Output indicators were consisted of production value, highway passenger transport, passenger transportation and rotation volume of passenger transportation, road freight volume and road freight turnover, shown in Table.1. Due to data limited of statistical yearbook of Jilin province, fixed capital investment was calculated by expenditure multiplied the proportion of transportation and warehouse expenditure divided total expenditure of Jilin province. Logistics employees were calculated by Employees of all sectors multiplied the proportion of transportation and warehouse employees divided employees of all sectors.

| Indicators | Indicators content                        | Code |
|------------|------------------------------------------|------|
| **Input**  |                                         |      |
|            | Fixed capital investment/billion yuan    | $X_1$|
|            | Employees of logistics/thousand people   | $X_2$|
| **Output** |                                         |      |
|            | Gross value of logistics/billion yuan    | $Y_1$|
|            | Volume of passenger traffic/thousand     | $Y_2$|
|            | Rotation volume of passenger transportation/ten thousand per kilometer | $Y_3$|
|            | Freight traffic/ten thousand tons        | $Y_4$|
|            | Cargo volume/thousand tons per kilometer | $Y_5$|

3.2. Methodology

There are mainly three conventional evaluation on logistics efficiency, including activity-based costing, analytic hierarchy process and data envelopment analysis (DEA). The basic DEA model use linear programming to solve the distance of each DMU to optimal production frontier, and deal with multi-input and output problems compared the distance.

Malmquist indicator was original proposed by Malmquist Sten. Caves (1982) first applied malquist indicator to measure changes of production efficiency. After that, malmquist indicator was integrated with DEA by researchers, in order to characterize better relative efficiency. Malmquist can be divided into followed form:

$$
M(x', y', x^{t+1}, y^{t+1}) = \left[ \frac{D_C^{t+1}(x^{t+1}, y^{t+1})}{D_C^t(x', y')} \times \left[ \frac{D_C^t(x', y')}{D_C^t(x^{t+1}, y^{t+1})} \right]^{\frac{1}{2}} \right]
$$

$$
\times \left[ \frac{D_C(x', y') / D_C^t(x', y')} {D_C(x', y') / D_C^{t+1}(x', y')} \times \left[ \frac{D_C^t(x', y') / D_C^{t+1}(x', y')} {D_C^t(x', y') / D_C^{t+1}(x', y')} \right]^{\frac{1}{2}} \right]
$$

$$
= TE \times TC \times SE = TC \times TEC
$$

Where, TE, TC and SE represented technology efficiency, technology change and scale effect on efficiency change respectively. When Malmquist is more 1, total factor productivity(TFP) had risen from t to t+1 and efficiency raised; When Malmquist is equal to 1, the TFP was unchanged and efficiency efficiency had no change from t to t+1. When Malmquist is less than 1, the TFP had decreased and efficiency was down from t to t+1. The TEC represented the degree of decision-making units (DMUs) catching up production frontier, namely changes of technology efficiency (TE). Technology change (TC) characterized the change degree of production technology and presented the movement of production frontier from t to t+1. For the subjects in the study was regional logistics efficiency and otherness of Jilin province, the research related to neither the muti-input and output nor
the logistics comparison of different period. Therefore, DEA-Malquist was selected to measure the logistics efficiency of Jilin province.

4. Emperical test and analysis
Based on the decomposition of Malquisit in third section, the TFP, TEC and TC can be calculated and shown in tab.2.

**Tab.2 Regional logistics Malmquist of Jilin province form 2010-2016**

| region   | indicators | 2010-2011 | 2011-2012 | 2012-2013 | 2013-2014 | 2014-2015 | 2015-2016 |
|----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Changchun| TFP        | 0.823     | 0.816     | 0.776     | 0.812     | 1.055     | 0.778     |
|          | TEC        | 0.843     | 0.796     | 1.931     | 0.869     | 0.709     | 1.001     |
|          | TC         | 0.816     | 1.025     | 0.402     | 0.934     | 1.489     | 0.777     |
| Jilin    | TFP        | 0.873     | 0.992     | 0.352     | 0.961     | 1.161     | 0.844     |
|          | TEC        | 1.000     | 0.990     | 0.987     | 1.106     | 0.699     | 1.056     |
|          | TC         | 0.873     | 1.002     | 0.356     | 0.946     | 1.662     | 0.800     |
| Siping   | TFP        | 0.999     | 1.269     | 0.828     | 0.913     | 0.894     | 0.799     |
|          | TEC        | 0.927     | 1.028     | 1.421     | 1.006     | 0.791     | 0.959     |
|          | TC         | 1.078     | 1.235     | 0.583     | 0.908     | 1.131     | 0.833     |
| Liaoyuan | TFP        | 1.176     | 1.206     | 0.560     | 0.958     | 1.065     | 1.006     |
|          | TEC        | 1.000     | 0.907     | 1.049     | 0.998     | 0.938     | 1.012     |
|          | TC         | 1.176     | 1.330     | 0.534     | 0.960     | 1.135     | 0.994     |
| Tonghua  | TFP        | 1.156     | 1.135     | 0.564     | 1.071     | 0.967     | 0.955     |
|          | TEC        | 0.985     | 0.860     | 1.480     | 1.050     | 0.678     | 0.974     |
|          | TC         | 1.173     | 1.320     | 0.381     | 1.020     | 1.428     | 0.980     |
| Baishang | TFP        | 0.910     | 1.290     | 0.671     | 0.922     | 1.387     | 0.907     |
|          | TEC        | 1.000     | 1.000     | 1.000     | 1.000     | 1.000     | 1.000     |
|          | TC         | 0.910     | 1.290     | 0.671     | 0.922     | 1.387     | 0.907     |
| Songyuan | TFP        | 1.180     | 1.191     | 0.514     | 0.905     | 1.042     | 0.909     |
|          | TEC        | 1.044     | 1.000     | 1.000     | 1.000     | 1.000     | 1.000     |
|          | TC         | 1.130     | 1.191     | 0.514     | 0.905     | 1.042     | 0.909     |
| Baicheng | TFP        | 0.997     | 1.045     | 0.394     | 0.900     | 1.094     | 0.798     |
|          | TEC        | 1.000     | 1.000     | 0.841     | 1.054     | 0.936     | 0.947     |
|          | TC         | 0.997     | 1.045     | 0.468     | 0.854     | 1.168     | 0.843     |
| Yanbian  | TFP        | 1.076     | 1.170     | 0.319     | 1.002     | 1.069     | 0.807     |
|          | TEC        | 1.000     | 1.000     | 1.000     | 1.000     | 1.000     | 1.000     |
|          | TC         | 1.076     | 1.170     | 0.319     | 1.002     | 1.069     | 0.807     |

4.1. Analysis on TPF of Jilin province from 2010-2016
Average logistics TFP can be calculated by table1., and the average on TEC, TC, TE, SE and TFP of main area of Jilin province were shown as tab.3.
The total factor productivity of Jilin main province increased first, then decreased and increased, had been slowing down finally. The TFP had been increased markedly, especially from 2010 to 2011. But the average TFP from 2010 to 2016 was less than 1 because the TFP had been decreased rapidly from 2012 to 2013. Still, the average TFP of Jilin province being increased during 2010 to 2016 was 1.0064 by weeding out extreme data of 2012 to 2013. From 2010 to 2011, the average logistics TFP growth of Jilin main area was greater than one, but TEC was less than one. That shown the TFP increased during 2010 to 2011 mainly depended on technology and innovation. In fact, with applying bar code, ratio frequency, GIS and GPS technology, main area logistics productivity of Jilin province has been enhanced. With applying new technology, the cost also had been increased. That was why the main area logistics TEC was greater than one. The average logistics TFP of Jilin province had been increased visibly from 2011 to 2012. Growth ratio on TC, TFP and TE were exceed one, but SE was only 0.953. These result shown that the main area average logistics TFP of Jilin province came from technology efficiency and TC had not also retrogressed during 2011 to 2012.

That means the main area TFP improvement of Jilin province depended on introducing foreign advanced technology, applying new technology and increasing investment on research and development; On the other hand the improvement also depended partly on ameliorating internal management system and level. It was noteworthy that the variable average on 9 regions TC, TFP and SE of Jilin province were 10.4%, 0.97% and 0.97% respectively. The result shown that TC was the top contributor to TFP. Contrast to 2010 to 2011, main area logistics TFP of Jilin province had obviously decreased during 2012 to 2013. Although during 2012 to 2013, TEC and SE were all greater than one but TC was only 0.470. Based on the calculation results, the TFP growth decreased was mainly from the rapid decline of TC. The reason mainly was declines of investment on logistics technology because the effect of China four trillion investment plan had gradually decreased and the uncertain on economic growth.

It's remarkable that the trend on logistics TFP decreasing had slowed down. The TFP and TC, which were 0.938 and 0.939 respectively, were all less than one, but compared with 2012 to 2013, the decreasing trend had obviously slowed down. It illustrated that logistics of Jilin province can actively take measures to respond to the profound changes of the macroeconomic environment at home and abroad, and also attained outstanding results. Especially, the TFP was greater than one again and reached 1.082.

Additionally, the logistics TFP and TC of Jilin province were highly correlated, both of them had strong consistency. That the TC was fundamental to TFP.

From view of results, the TFP was all less than one except 2012 to 2013 which reached 1.190 and average TFP was 0.998, annual fluctuation was slow. That illustrated the TC lagged had stunted largely the logistics TFP of Jilin province increasing. Except 2012 to 2013 and 2015 to 2016, the SE was all less than one. That shown the logistics SE of Jilin province was on the decline. The trend was reversed during 2012 to 2013 and 2015 to 2016, which illustrated the arranging logistics center and employment had promoted the logistics SE to some degree.
4.2. The analysis on average logistics TFP and otherness of Jilin province

As tab.4 shown, main area average logistics TFP of Jilin province were less than one except Baishang during 2012 to 2016. And the results shown the TFP had been declined 6.9% per year.

Tab.4 The average changes and decomposition on main area Malmquist of Jilin province

| Area     | TEC   | TC    | TE    | SE    | TFP  |
|----------|-------|-------|-------|-------|------|
| 1 Changchun | 1.047 | 0.912 | 0.986 | 1.060 | 0.843 |
| 2 Jilin   | 0.958 | 0.940 | 1.000 | 0.958 | 0.864 |
| 3 Siping  | 1.022 | 0.961 | 1.000 | 1.022 | 0.950 |
| 4 Liaoyuan| 0.984 | 1.021 | 1.000 | 0.984 | 0.995 |
| 5 Tonghua | 1.005 | 1.050 | 1.000 | 1.005 | 0.975 |
| 6 Baishang| 1.000 | 1.015 | 1.000 | 1.000 | 1.015 |
| 7 Songyuan| 1.007 | 0.948 | 1.000 | 1.007 | 0.957 |
| 8 Baicheng| 0.963 | 0.896 | 0.968 | 0.995 | 0.871 |
| 9 Yanbian | 1.000 | 0.907 | 1.000 | 1.000 | 0.907 |
| average   | 0.998 | 0.961 | 0.995 | 1.003 | 0.931 |

From the view of TC, the TC of Liaoyuan, Tonghua, Baishang were greater than one, which the areas mentioned above can meet with the challenge of knowledge economy, lead the competitive advantage and TC had become the key factor to improve logistics efficiency. But the TC of Changchun, Jilin, Siping, Songyuan, Baicheng, Yangbian were less one, which shown the areas mentioned above need improve logistics TFP by promoting TC.

From the view of TE, the TE of Changchun, Baicheng were less than one, others were equal one and the average TC was 0.995. That had shown the TC had stayed the same except few areas.

From the view of SE, the SE of Changchun, Siping, Tonghua and Songyuan were greater than one, Baishang and Yanbian were equal one, Jilin and Baicheng were less than one, and the average changes of TE were 1.003. That illustrated the main area logistics TE of Jilin province had shown a rising trend in general and the TE had become a key factor for improving the main area logistics TFP of Jilin province.

5. Conclusions and Suggestion

From analysis of part IV, the main factor affection main area logistics TFP improved was SE and TC was key factor stunted the logistics TFP of areas mentioned above. How to improve logistics efficiency effectively must focus on improving TC. Overall the result of table.1 to table.3, the conclusions can be attained.

First, the main area logistics TFP of Jilin province was in decline state basically; Secondly, TC, TE and SE had different influence on the TFP, but SE played a noticeable role on improving TFP. Third, the TFP were different in areas, for example, the TFP of Siping and Liaoyuan were similar, which were 0.950 and 0.995 respectively. However, the SE of Siping was 1.022 and Liaoyuan was 0.984. And the TC of Siping and Liaoyuan were 0.961 and 1.021 respectively. Last, the logistics efficiency of areas mention above fluctuated greatly, especially during 2012 to 2013. For example, the TFP of Liaoyuan and Tonghua was 1.176 and 1.156 respectively during 2010 to 2011, which had been changed to 0.560 and 0.564 respectively during 2012 to 2013.

The conclusions mentioned above had significant sense to understand the basic situation on logistics efficiency of Jilin province, can discover key factors which constrained logistics efficiency increasing and take all appropriate steps to increase logistics efficiency. Based on above conclusions, some suggestions had been advanced.

First, fully play roles of the macro-control of government and increase financial support.

Through establishment and implementation of adjustment and revitalization on logistics of Jilin province, break the administrative locks and benefits of main areas, and balanced logistics
development of Changchun, Jilin and Siping; Logistics park should be well laid-out through investigation, focus on quality development than speed and scale; Establish logistics enterprise funds to support logistics firms development and give financial support for pioneer logistics firms.

Second, main areas of Jilin province should attach great important on logistics technology while on TE and SE; Areas, which TE and SE were lower, should increase more attention to logistics distribution system, strengthen self-construction, introduce market-oriented reform to make genuine mobility of labor and capital by advanced experience on technology and resource configuration. In order to integrate resources and information, logistics firms must strengthen information integration, improve integrated management level so the level of new technology applying in logistics can be improved.

Third, put high value on TC declining, speed up main areas logistics innovation mechanism and system. In the long run, TC is the key factor to promote logistics firms TFP, so the government should support logistics firms to develop independent innovation and R&G. Meanwhile, logistics firms should continuously learn and apply advanced logistics technology, strengthen standardization, satisfy personalized needs and improve logistics specialized and personalized service level.

Fourth, main areas of Jilin province should prepared actively for “new normal” of China's, quicken adjustment optimization of industries structure, dispel technical barriers and reduce logistics efficiency disparities among main areas. Meanwhile main areas logistics of Jilin province should keep close connection with Heilongjiang and Liaoning, maximize the development of logistics and promote logistics system overall efficiency with the opportunity on vitalization of traditional industry base of the northeast and development of cross-border e-commerce.

Fifth, main areas government of Jilin province should face the opportunity and challenge to increase more investment on logistics infrastructure based on national relevant policies, utilize the opportunity of revitalize northeast industrial base and “internet+circulation” plan to accelerate improvement of main areas logistics information level of Jilin province. Jilin province should set up main areas logistics information platform efficiently and timely by using advanced technology, such as big data and internet of things. Meanwhile logistics firms of Jilin province must introduce information talent to ensure information channel freely and raise information level of logistics and supply chain.

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