Analysis of Electricity Consumption and Kinetic Energy Index in Fujian

Analysis of Electricity Consumption and Kinetic Energy Index in Fujian

Kangli Xiang[1], Xiangjing Qiu[2], Chao Xun[2], Lin Liu[1] and Shanglong Chen[3]

[1]State grid Fujian economic research institute, Fujian Fuzhou 350001, China
[2]State grid Fujian electric power company, Fujian Fuzhou 35001, China
[3]Great power science and technology corporation state grid Information & Telecommunication group, Fujian, Fuzhou, 350003, China

Abstract. The growth situation of emerging industries and new kinetic energy can be reflected by improving the statistical system of the “three new” industries. New ideas for the study of the "three new" industries are provided by the statistical analysis based on power big data. This paper studied the power big data of 2,084 "new industry" enterprises in Fujian province from 2014 to 2018. The research is divided into "new industry" electricity consumption analysis and "new industry" kinetic energy index research. First, the analysis is made for development trend, proportion, seasonal trend, different region and industry’s electricity characteristics of the electricity consumption in new industries. Second, the indicator system of "new industry" in Fujian is constructed. The results showed that," new industries" are booming in Fujian province, but the momentum for development has weakened in 2018.

1. Research background

1.1. The current situation of "three new industries”

New industries, new formats and new business models are included in “three new” industries [1-2]. New industry refers to the new economic sector or new industry generated by the application of emerging technologies and advanced scientific achievements in production activities [3-4]. It includes new industries generated by the industrialization of new technology application, new industries formed by the use of modern information technology in traditional industries, and new industries derived from industrial differentiation, upgrading and integration [5-7]. The new format presents conforming to diversified, diversified and personalized demands for products or services. It is relied on technological innovation and application, new links, new chains and new forms of activities derived from existing industries and fields. In order to realize the maximization of customer value and the long-term sustainable profit of the enterprise, the business operation model with core competitiveness integrates internal and external elements of the enterprise, and relies on technological innovation and application. With the rapid development of economy, it is the core work to cultivate and strengthen new driving forces and accelerate the development of new economy. The incubation and growth of the "three new industries" have played a crucial role in promoting the transformation and upgrading of China's economic structure, improving the quality and efficiency of growth and maintaining steady growth [8-9]. Promoting the "three new areas" of statistics, accelerating the establishment and improvement of the "three new areas" of statistical investigation system, measuring new drivers of growth and reflecting

new developments in a real, accurate, complete and timely manner, will be the top priority of the current and future statistical reform and development [10]. In February 2017, the statistical classification of new industries, new business forms and new business models (trial) was issued.

1.2. Application of power big data in "new industry" statistics

Power big data is generated in the process of power production, and the data source involves all links of power generation, transmission, substation, distribution, power consumption and dispatching of power production. Large quantity, multiple data types, fast processing speed, high data accuracy and strong data timeliness are the common characteristics of power big data. At the same time, the relationship between the power industry and the national economy is inseparable, and power data and economic data are inextricably linked. Therefore, the research and analysis of the power big data of the "three new" industries can reflect the development status of the "three new" industries. Compared with the study of traditional economic data, high timeliness and accuracy are the advantages of the power big data. Due to the stability and large scale and relatively complete power data accumulation of "new industry" enterprises, this paper carries out statistical analysis in key fields such as emerging industry and high-tech industry.

2. Power consumption analysis of "new industry" in Fujian province

According to the classification description of "new industries", it includes strategic emerging industries, high-tech industries and other classification methods. In this paper, 185 strategic emerging enterprises, 319 high-growth enterprises and 1,688 enterprises corresponding to the industry classification of high-tech industries published by Fujian economic and information technology commission are selected as research objects.

The electricity consumption of enterprises in the "new industry" from 2014 to 2018 is analyzed, and the electricity consumption of enterprises is shown in figure 1. From 2014 to 2018, the average monthly electricity consumption of the "new industry" was 928 million KWH, and showed a steady upward trend year by year, which indicating that the "new industry" is very effective in the process of industrial structure upgrading.

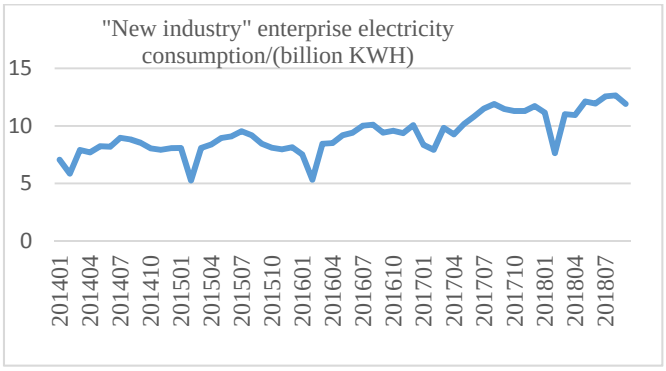

Figure 1. The electricity consumption trend chart of "new industry"

The growth rate of electricity consumption in the "new industry" is shown in figure 2. The average growth rate in 2015 was 5.77%, which presents relatively stable growth between months. In 2016, the average growth rate was 1.64%. In the first quarter, it showed negative growth. In the second and third quarters, it maintained stable growth. In 2017, the average growth rate was 17.82%, showing a trend of rapid growth. Until 2018, the average growth rate has slightly decreased, but the overall growth rate remains relatively high.

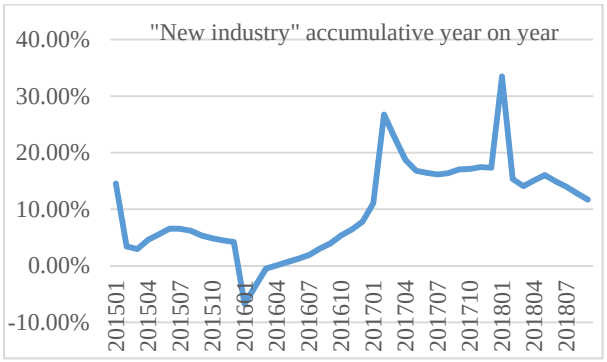

Figure 2. "New industry" electricity consumption cumulative growth trend chart

Based on the time series decomposition method of STL (Seasonal and Trend decomposition using Loess), the time series of total power consumption of "new industry" is decomposed into three parts: trend factor, seasonal factor and random perturbation factor, and is shown in figure 3. Where the blue line is the trend factor, the orange line is the seasonal factor and the green line is the irregular factor.

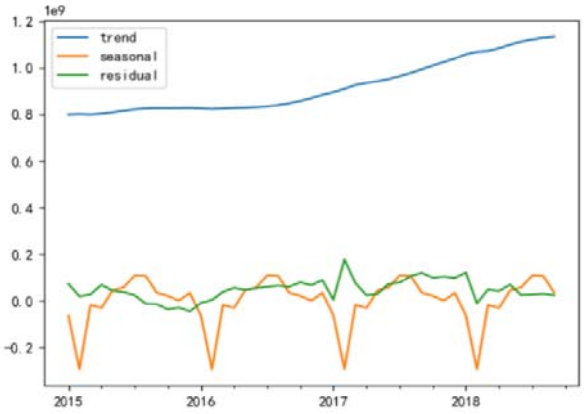

Figure 3. The time series decomposition chart of "new industry" enterprise

Analyze the influence of seasonal factors on total electricity consumption. According to the proportion of average seasonal factors in figure 4, the "new industry" in February, July, August and other months was significantly affected by seasonal factors (the negative sign represents the direction, and the absolute value represents the magnitude of the influence). The biggest impact was in February, at -23.81 percent, followed by July at 10.08 percent. In addition, the rest of the month is affected by seasonal factors are less than 10%.

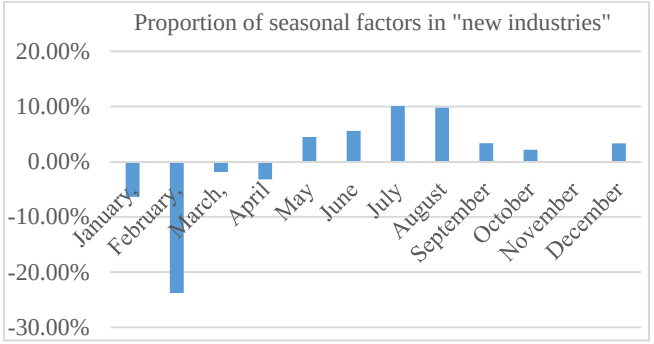

Figure 4. The time series - seasonal factor diagram of "new industry" enterprise

The "new industry" of Fujian province has played an important role in the process of industrial upgrading and structural adjustment. First, electricity consumption has maintained a steady growth, and is steadily increasing year by year compared with the secondary and tertiary industries. With the average monthly electricity consumption of 928 million KWH and the cumulative growth of 10.01%, from 2014 to 2018, the electricity consumption of "new industry" enterprises in Fujian province has remained a stable growth. The steady growth of the second and third industries reflects the accelerating pace of the optimization and upgrading of the power industry structure in our province. Although the domestic economy is facing great downward pressure, "new industry" electricity still maintains the good situation in recent years. Second, the seasonal factors of "new industry" are obviously affected by temperature and holidays. By analyzing the time series of electricity consumption through x-11, it can be seen that "new industry" is greatly affected by seasonal factors in February, July and August. The biggest impact occurred in February, which reached -23.81%, mainly due to the shutdown of most enterprises during the Spring Festival. Secondly, the growth rate in July was 10.08%, mainly due to the rise in temperature, enterprises use electricity to use air conditioning and other refrigeration electrical power increase. In addition, the rest of the month is affected by seasonal factors are less than 10%.

3. Study on kinetic energy index of "new industry"

3.1. Research ideas

In physics, kinetic energy is the amount of energy when an object moves, which as a function of its mass and its current velocity. The development and change of regional electric power have many similarities with the movement of objects, and it also has a kind of energy of movement and change. This paper applies the kinetic energy theory in physics to the field of power economics. Based on the research on the development status of "new industry" electric power, the concept of kinetic energy index of regional electric power and industrial electric power development is put forward. Based on the big data of electric power, and taking the scale and speed of industrial development into consideration, a model reflecting the development momentum of regional electric power and electric power industry is constructed to explain, judge and analyze the overall development situation of "new industry" electric power.

3.2. Theoretical basis

3.2.1. Kinetic energy index model. The kinetic energy index should reflect the changes in the electricity consumption situation and economic situation of the new industry from the two aspects of scale and growth rate. The kinetic energy index can be defined by the multiplier model of the two indicators:

$$E_t = \frac{m_t^p v_t^{2-p}}{100} \tag{1}$$

Where, E_t is the electric kinetic energy index of t period; m_t is the power scale index of t period; v_t is the power growth index in t period; p is the weight parameter, and the initial value is set to 1. The greater the p is, the greater the influence of the scale index on the kinetic energy index will be; otherwise, the greater the influence of the velocity index on the kinetic energy index will be.

3.2.2. Index compilation theory. The index system consists of three elements: the constituent elements (i.e. index), the corresponding structure level, and the quantity (i.e. weight) reflecting the importance of the index to the research object.

The establishment of index system adopts two methods: qualitative analysis and quantitative analysis. Firstly, a comprehensive index system framework is established by qualitative analysis. Secondly, quantitative analysis was used to screen the index system.

3.3. The electric power kinetic energy index system Fujian province

3.3.1. Data collection and preprocessing. Based on the marketing database and acquisition database to obtain the original data, the application of data cleaning, data integration, data conversion and other data preprocessing methods to complete the data preprocessing, and finally get the sample data used to build the model.

3.3.2. Index selection. The "new economy" kinetic energy index includes the size index and the growth index. Scale index represents the volume scale in the development process of the new industry, which includes three indicators :(1) the proportion of electricity consumption of the new industry in the whole industry; (2) the ratio of new industry operation capacity to the whole industry operation capacity; (3) number of enterprises. Among them, the first index reflects the contribution of new industry enterprises in the whole social production. Electricity consumption can reflect the expansion or contraction of enterprise utilization rate and social demand. With the same energy consumption structure, the larger the power consumption is, the larger the production scale will be. Therefore, when the proportion of electricity consumption of new industry in the whole industry increases, it indicates that the scale of new industry in social production activities expands, and vice versa.

The second indicator is an important indicator reflecting the scale of the new industry. Business expansion will cause changes in operating capacity. Business expansion is to accept customers' application for electricity, make safe, economical and reasonable power supply plan based on customers' demand for electricity and the situation of power supply network. It can reflect the future production capacity and respond in advance to the expansion of electricity consumption scale of enterprises in the future.

The speed index represents the speed of development in the process of new industry development. It includes four indicators: (1) the growth rate of electricity consumption; (2) increase of operating capacity; (3) enterprise arrears; (4) the growth rate of the number of enterprises.

Among them, there is a negative correlation between the amount of time in arrears and the operating status of enterprises. The well-run enterprise has sufficient cash flow, relatively positive payment of electricity charges, and short average arrears. Companies with troubled operations are more likely to fall behind on their electricity bills, with a longer average bill arrears. In addition, when the index system is established, data transformation is needed to the overdue time data of the enterprise, so that it can reflect the advantages and disadvantages of the enterprise operation in the same direction. In summary, the index details are shown in table 1:

Table 1. Index list

	Scale indicator			**Speed indicator**			
The index name	Electricity consumption	Percentage of operational capacity expansion	Number of enterprises	The increase of electricity consumption	Expansion of operating capacity	Payment cycle	The growth of the number of enterprises

3.3.3. Calculation of kinetic energy index. The scale index and velocity index in the kinetic energy index model are calculated by using the composite index method. According to the kinetic energy index model, the scale index and speed index are combined to obtain the kinetic energy index, which is based on the year 2015 and set as the base value of 100.

3.4. Construction of new industry kinetic energy index in Fujian

3.4.1. Scale index. The scale index includes three indicators: the scale of electricity consumption, the scale of operating capacity and the number of enterprises. That is, the ratio of electricity consumption to the whole industry of "new industry", the ratio of operating capacity to the whole industry of "new

industry" and the number of enterprises. The three indexes are synthesized into the scale index through the synthesis index method. As shown in figure 5.

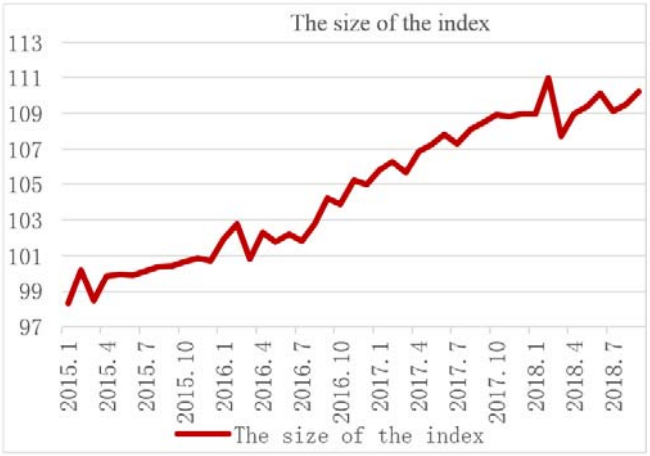

Figure 5. Scale index diagram

Power consumption scale curve (proportion of new industry's power consumption in the whole industry) and operating capacity scale curve (proportion of new industry's operating capacity in the whole industry's operating capacity) are shown in figure 6.

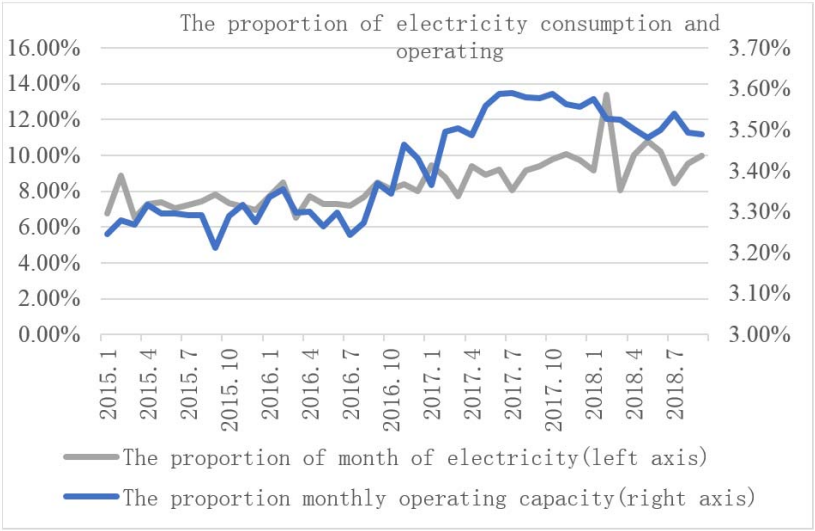

Figure 6. The proportion of power scale - operating capacity

From the above analysis results, it can be seen that the new industrial scale development rules observed based on power data mainly embody the following characteristics:

(1) The scale of the new industry increases year by year. The industry size index rose from 100 in the benchmark index in 2015 to 110.2 in September 2018, and the upward trend is stable without significant fluctuations. It can be seen that with the continuous expansion of the development scale of "new industry" in Fujian province, the importance of the whole industry gradually increases.

(2) The scale of new industries began to accelerate in the third quarter of 2016. By observing each sub-index of the scale index, it can be found that the main reason for this situation is that the proportion of electricity consumption and the proportion of operating capacity increases faster.

3.4.2. Speed index. First, the speed index includes the growth rate of electricity consumption, operation capacity, payment duration and the number of enterprises. It is considered that if the duration of payment is longer than 7 days, it is deemed as poor business performance; if the duration is less than 7 days, it is deemed as good business operation. The number of enterprises with poor operating efficiency is taken as the index representing the time length of payment. Through data transformation, it can better reflect the prosperity degree of the industry from the perspective of payment enthusiasm. The speed index is obtained by compositing the growth rate of electricity consumption, business expansion, enterprise arrears and the growth rate of enterprise quantity, as shown in figure 7. The sub-indexes are shown as figure 8 and figure 9.

Figure 7. The index of speed

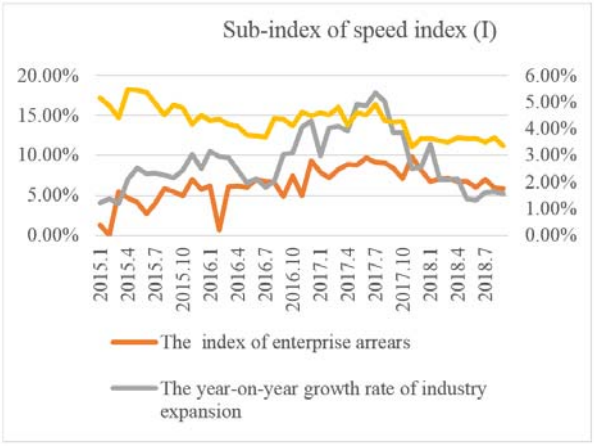

Figure 8. The trend chart sub-index (I)

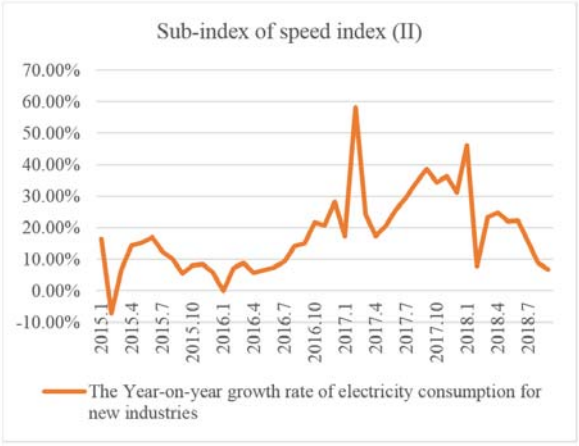

Figure 9. The trend chart sub-index (II)

By analyzing the velocity index and its sub-index, the following conclusions can be drawn:

(1) The new industry maintained a high growth rate in 2017, and then rapidly fell back and was lower than the base year level.

(2) The high level of the new industry speed index in 2017 is caused by the rapid growth of electricity consumption and operation capacity of the new industry.

(3) From 2018, all sub-indexes of the new industry speed index show a downward trend. Reflect the new industry development gradually slowed down.

3.4.3. Kinetic energy index. According to the power kinetic energy index model, the power kinetic energy index is calculated by combining the scale index and speed index, and the trend chart of power kinetic energy index of "new industry" is obtained as shown in figure 10. As can be seen from the figure, in 2015, there was a trend of rising first and then falling, and the "new industry" kinetic energy index was 100. The first half of 2016 continued the weakness at the end of 2015. In the third quarter, the "new industry" momentum index was 101.65, increase by 1.65 at that same time as last year; In the first half of 2017, the kinetic energy index continued to rise strongly, significantly higher than the level of the previous two years, showing a high and stable trend. Growth slowed in the fourth quarter and the "new industries" momentum index was 107.49. As of September 2018, the kinetic energy has fallen back, but it is still higher than the level in 2015 and 2016. The "new industry" kinetic energy index is 105.73 for the whole year.

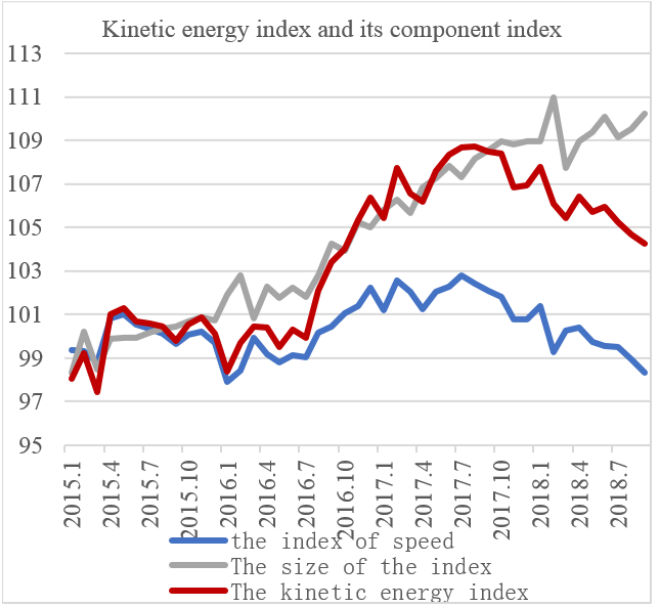

Figure 10. Scale index trend chart

By analyzing the kinetic energy index and its sub-indexes (scale index and velocity index), the following conclusions can be drawn:

(1) The new industry showed a slow development trend before the third quarter of 2016. The scale of new industries has increased slightly, but at a lower speed.

(2) The rapid increase in the momentum index of new industries since the third quarter of 2016 is due to the increase in the development scale of new industries and the accelerated development speed.

(3) After the third quarter of 2017, the new industry kinetic energy index began to decline gradually, which was mainly because of the decline in the development speed of new industries, while the scale of new industry development remained at a high level.

4. Summarize

Based on the power big data, this paper conducted a comprehensive analysis of the power consumption characteristics of the "new industry" in Fujian province, and constructed the kinetic energy index of the "new industry" in Fujian. The conclusions are as follows:

High growth rate, strong seasonal fluctuation and obvious agglomeration effect are the characteristics of "new industry" in Fujian. So, economy faces bigger pressure, "new industry" use electricity still maintains the situation of high-speed growth. Fuzhou, Xiamen, quanzhou as the core location of the formation of industrial clusters. The development momentum of "new industry" in Fujian is influenced

by two factors: scale and speed. Based on the research results of power big data of Fujian province, the development scale index of "new industry" in Fujian province shows a trend of increasing year by year, and "new industry" plays an increasingly important role in the economic development of Fujian province. After reaching its peak in the first half of 2017, the development speed index of "new industry" in Fujian province gradually declined, falling back to the level of 2015. According to the scale index and speed index of "new industry" in Fujian, the kinetic energy index of "new industry" in Fujian is synthesized. The research results show that the development momentum of "new industry" in Fujian from 2015 to 2018 can be divided into three stages. The first stage is from 2015 to august 2016. The fluctuation range of development momentum is small and at a low level. The second stage is from 2016.8 to 2017.8. The growth momentum of "new industry" increases sharply. The third stage is from 2017.8 to 2018.9. The momentum of development gradually recedes from the high level in the previous stage, but it is still higher than that in 2015 and 2016.

References

[1] L. E. H. Godfrey, S. S. Shabala. Agn jet kinetic power and the energy budget of radio galaxy lobes, The American Astronomical Society, 2013, 767 (12): 1-9.
[2] Zhao shunzhao. "Three new" statistics [J]. China statistics, 2016 (08): 55-57.
[3] Miao hongtao. Strong growth momentum of shenzhen "three new" enterprises -- survey report on shenzhen "three new" small and micro industrial enterprises [J]. China statistics, 2016 (09): 59-60.
[4] Wang meifu, Wang weiwei. Economic accounting and empirical research on "three new economy" in zhejiang province, zhejiang province [J]. Journal of statistical science and practice, 2018 (01): 10-12.
[5] Xin jinguo. Exploration of factors affecting the quality of statistical data of "three new" enterprises under the background of big data [J]. Statistics and decision-making, 2017 (16): 2+189.
[6] Li qianqian, Wang yafen. Big data promotes the statistical classification reform of "three new" economic enterprises [J]. China statistics, 2018 (09): 16-17.
[7] Xia guozheng. Reflection on improving the quality of "three new" statistical data of enterprises [J]. China statistics, 2018 (07): 48-49.
[8] Wang liqun. Solving the "three new problems" problem with machine intelligence [J]. China statistics, 2018 (05): 27-29.