The Research on Situation and Prediction of Anqing's Industrial Economy

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Abstract. Industry is the dominant of national economy. The development of industrial economy becomes an enduring and dynamic topic with generally increasing of the second industry. Based on the qualitative method and data, we illuminated its current situation and found some problems, on account of the statistical analysis of economic development since the reform, we predicted the development trend of Anqing's industrial economy for a period of time and hope to provide some ideas for other scholars' related research.

Introduction

In recent years, Anqing City, the industrial economy has made considerable progress, the economic structure has undergone significant changes, and gradually developed from an agricultural region to an industrial region. Currently, the opportunities to accelerate the development speed of the industrial economy in Anqing are rare. First, with the transformation of economic development stage, part of the industry began to gradually shift from the Yangtze River Delta region to central and western regions. Moreover, the central government's *Opinions on Promoting the Rise of Central China* put forward some views and policies which support the planning and construction of large coal reserves center along the Yangtze River, strengthen energy and raw material bases in Central region, modern equipment manufacturing and high-tech industry base construction. Apart from that, *Hefei Economic Circle Urban System Plan*, which put forward by the government of Anhui Province, aim to build an economic circle space layout include *He Tong An* (Hefei, Tongcheng, Anqing) development belt, with the provincial capital economic circle as the center, based on the city-cluster along the Huaihe River and Yangtze River, creating an inter-city, one-hour commuting circle and living area, covering almost all economic regions of Anhui Province, to improve its industrialization and urbanization. The last one is the instruction of the State Council about promoting development of the Yangtze River economic zone on the basis of the golden waterway. As once one of the five well-developed city along the Yangtze River, Anqing is now the regional center of the city of the Yangtze River economic belt. In addition to presenting the enhancement of the function of the Yangtze golden waterway and construction of an integrated three-dimensional transport corridor, also highlighted the optimization the urbanization pattern along the Yangtze river, pushing industry from factor-driven shift to innovation-driven, vigorously develop strategic emerging industries, accelerate the transformation and upgrading of traditional industries, holding an new all-round opening up advantage, innovating coordinated regional development mechanism. As the chief axis city of the industrial transfer demonstration region along the Yangtze River in Anhui, Anqing will usher in a new development opportunity with the new policy.

Anqing has just entered the middle stage of industrialization; its task is quite arduous. Development experience of domestic and international has proven, in the stage of industrialization, economic growth in the industrial sector, productivity levels and productivity growth are significantly higher than the first and tertiary industries. The development of industry laid the foundation for the entire economy, it is an important support in the growth of today's social and

economic quality. Although the world has entered the information age, the industrialization of a developing country or region is still an insurmountable stage.

In the *Eleventh Five-Year National Plan* period, Anqing has made considerable economic and social progress. For the specific conditions of Anqing City, the implementation of industry-oriented development strategy is an important task to guide future economic development in Anqing City. As the main battlefield of building *Four Anqing*, industry is the strength source of the city progress. With the impact of domestic and international environment, the pressure of industrial economic development in Anqing city has increased, stabilizing and accelerating industrial growth is the top priority of the city's economic growth, supporting the steady growth of the industrial economy is the entry point of the city's economic development. Thus, speed up the process of industrialization, expand industrial scale, enhance industrial comprehensive strength and core competitiveness, and give full play to the leading role of industry which support in economic and social development, is important to the implementation of the policy, strategy, as well as to achieve the strategic objectives of economic growth.

The National Economy and Industrial Development Status in Anqing

In 2013, the annual GDP of Anqing was 141.82 billion yuan, it ranked the third in the province, according to comparable prices, it was an increase of 10.5% over the previous year. Among them, the increase of secondary industry was 75.41 billion yuan, up by 12.9%, The GDP per capita was 26,596 yuan. There has been a progressive decrease in GDP every year in Anqing. In 2013, the growth rate ranked the seventh in the province. However, the total GDP was still stayed in the top four. According to Table 1, the economic growth of Anqing and Maanshan were similar. Hefei and Wuhu were the top and the second on the board. In 2010-2013, GDP of Anqing was higher than Maanshan, but from the point of view of growth, the GDP growth was only 1.1% higher than the Maanshan in 2011, the other years were even less. Compared with the rapid development of several cities in the province, although Anqing had a higher GDP, but its growth rate was lower. [1,2]The foundation of the national economy development in Anqing is quite healthy, but the pace of development still needs improvement(Table 1).

Table 1 Growth comparison table of main urban cities in Anhui Province

Year City	2013	2012	2011	2010
Hefei	11.5%	13.6%	15.4%	17.5%
Anqing	10.5%	11.5%	13.2%	13.6%
Maanshan	11.0%	12.0%	12.1%	15.0%
Wuhu	12.0%	13.8%	16.0%	18.2%

In recent years, Anqing has put forward the development plan for industries and enterprises, focus on characteristic zone, innovation of technology, low-carbon and green development, incentive policy and investment attraction. Industrial economic developments in Anqing are stable[3], above-scale industrial economic development experienced from accelerant to placid, and then back to accelerant again. The above-scale industrial added value of Anqing was only 10.554 billion yuan in 2005, after the promotion of the *Eleventh Five Year Plan*, the development of the industrial economy had speed up, in 2010 it reached 36.873 billion yuan, an increase of 46.96% over the previous year. In 2011 and 2012, the development slowed down, above-scale industrial added value was 45.507 billion yuan and 47.641 billion yuan, an increase of 23.42 % and 4.69% over the previous year. In 2013, there was another accelerant trend (As it shows in Fig. 1).
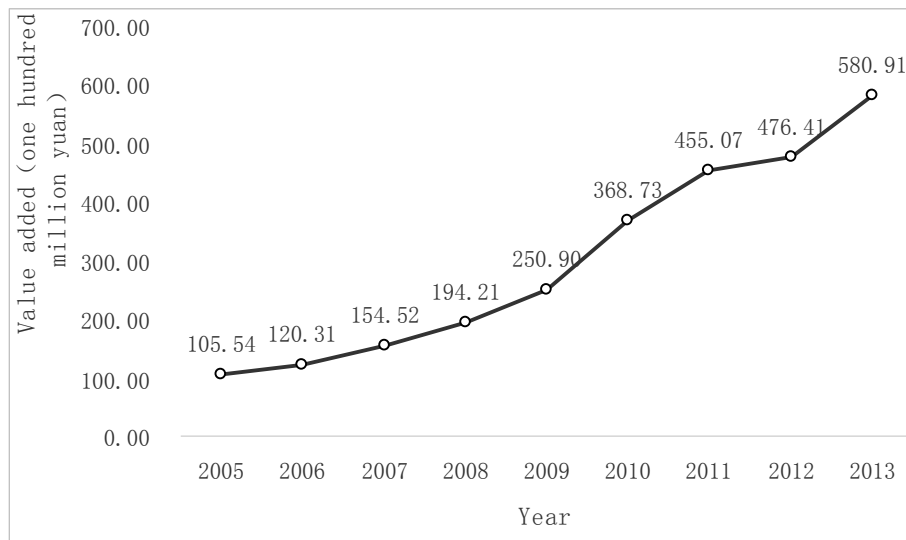
Fig.1   Above-scale industrial added value of Anqing in 2005-2013

There are a variety of international standards about the division of industrial development stage, the relatively influential and widely accepted one is *Chenery industrialization stage theory*, the theory regards the level of GDP per capita as an important indicator of economic development, the economic development stage are quasi-industrialization phase (primary production stage), stage of industrialization (primary stage of industrialization, industrialization intermediate stage, the advanced stage of industrialization), post-industrial stage (primary stage of developed economies, advanced stage of developed economies).

In 2013, the per capita GDP of Anqing was 26,596 yuan, equivalent to approximately $ 4,252, according to Chenery Industrialization Stage Theory, Anqing should be in the early middle stage of industrialization. If the per capita GDP growth is between 13% and 15%, Anqing will need nearly seven years to enter the advanced stage of industrialization, then after another five years it can enter the primary stage of developed economies, and enter the advanced stage by 2030, it shows that the road to industrialization needs at least a dozen of years.

The Problems in Industrial Economic Development of Anqing

GDP per capita is too low, the industrial economic growth is relatively slow. In recent years, although GNP in Anqing is relatively considerable, but the larger the population is, the lower GDP per capita is. Calculated at comparable prices, in 2005, GDP per capita of Anqing was 342.5 yuan less than the province's average number. In 2013, GDP per capita was only 1840.9 Yuan, that was a 962.5 yuan less than the provincial average, and the gap was widening every year. At current prices, disposable income per capita of urban residents was only 22,683 yuan in 2013, it ranked tenth in the province. The rural disposable income per capita was 7,748 Yuan, which ranked the twelfth of the province. Low GDP per capita also means that the distribution per capita of the economic value added by industry is low, which may adversely affect the development of industrial economy in Anqing.

Anqing has adequate industrial investment, but its growth is relatively slower. In 2010-2013, the industrial added value growth rate of the major cities in the province slowed down each year, and the differences are shrinking each year. In 2013, the growth concentrated between 14% -15%. In 2010, above-scale industrial added value growth rate of Anqing was 5.5% higher than the Maanshan, the gap was gradually narrowing after. In 2011, 2012 and 2013 the growth rate was slightly lower than in Hefei and Wuhu, in 2013, Anqing City Industrial investment rose 21.4%, ranked only eighth in the province, the above-scale industrial added value growth rate was 14.3%, ranked seventh in the province. The above-scale industrial added value and its growth rate matches its provincial ranking, which also shows the synchronization of industrial investment and industrial development.

The industry level is low, the industry chain is short. Industry development of Anqing relies on resources, and most of them are non-renewable resources, such as iron and ore. The products are mostly primary-process, such as the yarn, cloth, oil, gasoline, diesel fuel, cement and so on. The industrial development level, as it shows in Table 2,the industry chain and the processing depth are the major issues that Anqing will have to face.

Table 2   Industrial products production in Anqing in 2013

Product Name	Unit	Absolute Value	Growth Rate(%)
Yarn	Ten thousand tons	25.6	2.6
Cloth	Myrialiter	23969.2	0.3
White Spirit	Thousand liters	9975.8	33
Power Generation	Million kilowatt hour	627466.7	13.2
Crude Processing Volume	Ten thousand tons	550.8	31
Gasoline	Ten thousand tons	126.9	52.8
Diesel	Ten thousand tons	224.2	24.5
Cement	Ten thousand tons	753.3	34.4
Fertilizer	Ten thousand tons	13.53	-15
Synthetic Detergent	Ten thousand tons	11.1	-18.8

The contribution of agriculture to the national economy is relatively larger, the tertiary industry lags behind.

In 2000, Anqing City, the contribution rate of first industries to the GDP was 37.21%, far higher than the average level of the province, despite the contribution rate showed a decreasing trend in recent years, and in 2007 and 2013 it even lower than the level of the province, the overall figures are substantially higher than the province.[4] High contribution of agriculture to the national economy, means that the contribution and stimulating rate of the second industry, the tertiary industry are not enough, in 2013 the contribution of the tertiary industry in Anqing City, was only 27.33 %, that is 2.71% lower than the province's level. The tertiary industry pulling rate was 2.87%, 0.24% lower than the provincial average figure. The figures of other industries are lower than the provincial average level except the contribution of the financial industry, which is far higher than the national and provincial level (Table 3). In 2013, the real estate investment in Anqing was only 14.98 billion yuan, ranked the seventh in province. The contribution of agriculture to the national economy in Anqing is relatively larger, the tertiary industry development lags behind, it will restrict the development of industrial economy.

Table 3 The third industrial structure comparison table of China, Anhui and Anqing(%)

Project Area	The Third Industry	Transportation, Warehousing and Postal Service	Wholesale and Retail	Accommodation and Catering Industry	Financial Industry	Real Estate	Else
China	100	10.4	21.2	4.4	12.8	12.7	38.5
Anhui	100	11.2	21.6	4.7	11.7	12.1	38.7
Anqing	100	8.0	19.4	8.4	20.7	9.4	34.3

The contribution of the industrial economy and stimulating effect on the economy need to be enhanced. Over the past decade, the contribution and stimulating rate of the industrial economy to the national economy in Anqing was volatile, and the growth trend was not obvious. In 2000, Anqing's industrial economic contribution rate was 36.07%, the stimulating rate was only 2.46%. In the first year of *The 11th Five-Year Plan*, the contribution rate soared to 66.61%, the stimulating rate also increased by 3.61%. There was a rapid decline in 2006, after negative growth in 2012 and 2013, although the industrial contribution rate had a slight rise tendency, an increase of 0.96% over the previous year, the industry continued to show a decline in the stimulating rate, from the highest point

in 2011 fell to 6.85%. The contribution and stimulating growth of the industrial economy to the national economy is low and not stable, it shows that the pace of economic development in Anqing industry needs to be improved.

The Tendency Prediction on Industrial Economy Development of Anqing

Since reform and opening up, economic development of Anqing city has made brilliant achievements, GDP in 2013 has increased by nearly 20 times (in the 1978 constant prices), but must see that the economic development of Anqing is developing forward in waves, it presents the gradual characteristic. The speed of Anqing's economy growth is slow in 1979-1991. Annual increment in 1981 was 261 million yuan (constant prices), maximum growth rate of 18%, but the average annual growth rate of only 6.68%, and the value has a tendency to decrease year by year. Affected by inflation, Anqing's economy began to decline in 1988, only 4.5% growth in 1988-1991. In 1991, national macroeconomic policies began to relax, 1992-1996 is the golden period of Anqing city economic growth with an average annual growth rate of 16.41%, 1997-2006 is the wandering period of Anqing's economic growth. Due to the implementation of the eleventh five-year plan, Anqing showed a trend of "payable" to the economic growth started in 2007, Until now, the city economic growth is still stable, but what development state will be showed in the future? It needs to make a scientific quantitative analysis further.

The secondary exponential smoothing method. Quadratic exponential smoothing is a kind of method that forecast the future trend of the data especially widely used in the field of economic management. It smoothes the time series of historical data , namely forms the weighted average of the data of linear model to predict the future. In exponential smoothing, the choice of α is critical to the success of the forecast, in practice, α is selected according to the change of time sequence features, if the change of time series is not big, α should take some small, such as 0.1 to 0.3, if the change of time series has obvious tendency, α should take a few bigger, such as 0.6 to 0.9, it is actually an empirical data, by comparing multiple values trial, which value of prediction error is small, which is used[6]. Set single exponential smoothing value is α , the secondary exponential smoothing value calculation formula is:

$$S_t^{(1)} = \alpha y_t + (1-\alpha)S_{t-1}^{(1)}$$
$$S_t^{(2)} = \alpha S_t^{(1)} + (1-\alpha)S_{t-1}^{(2)}$$

(1)

$S_t^{(1)}$ denotes the single exponential smoothing value of year t, $S_t^{(2)}$ denotes the secondary exponential smoothing value of year t, α is the smoothing coefficient. 1-α is the damping coefficient. We can use $S_t^{(1)}$ and $S_t^{(2)}$ to make an estimate of the intercept of the linear model:

$$a_t = 2S_t^{(1)} - S_t^{(2)}$$
$$b_t = \frac{\alpha}{1-\alpha}\left(S_t^{(1)} - S_t^{(2)}\right)$$

(2)

The linear model formula to predict the secondary exponential smoothing value is:

$$\hat{y}_{t+m} = a_t + b_t m$$. m=1, 2, 3……

(3)

Here is a table of the second industry and the industrial production index of Anqing (is shown in Table 4).

Table 4 The second industry and the industrial production index of Anqing(1978=100)

Year	The Second Industry Index	The Industrial Production Index	Year	The Second Industry Index	The Industrial Production Index
1978	100.0	100.0	1996	508.8	503.5
1979	108.6	108.6	1997	528.1	527.0
1980	112.8	109.4	1998	569.3	561.6
1981	144.7	141.7	1999	587.6	579.0
1982	131.9	125.4	2000	624.6	618.2
1983	125.5	116.5	2001	640.0	624.5
1984	142.3	133.3	2002	687.0	660.7
1985	173.4	164.4	2003	741.9	706.9
1986	207.2	189.8	2004	832.6	792.8
1987	222.6	199.1	2005	989.7	962.1
1988	252.2	228.6	2006	1111.2	1085.1
1989	242.4	237.5	2007	1279.3	1274.2
1990	235.3	229.7	2008	1458.1	1478.5
1991	253.4	246.9	2009	1715.3	1758.6
1992	305.1	303.2	2010	2045.7	2134.0
1993	359.3	367.2	2011	2414.5	2556.8
1994	397.5	404.1	2012	2758.7	2947.0
1995	454.5	455.2	2013	3115.2	3351.7

The prediction of added value of the second industry index. Quadratic exponential smoothing model has significant practical significance for fitting and forecasting of time series, thus the method can be used reasonable for the second industry and the industrial production index, index of the added values of the second industry from 1978 to 2013, a total of 36 samples, because of its high n (n = 36), The initial value has little effect on the prediction results later[7], Take the initial value $S_0^{(1)} = S_0^{(2)} = 100$. The added value of the second industry index rises fast as the increasing of time obviously, therefore, according to the experience judgment method, α should take larger value, between 0.6 and 1.0. Minimum error sum of squares can be the standard of the best selection, the best α should make SSE smallest, if sets precision 0.01, through the exhaustive method we can infer that

the best α is 0.99. $S_0^{(1)} = S_0^{(2)} = 100$, By the tabular data, Y_1=100, Y_2=108.6, Y_3=112.8.When t=1,

$$S_1^{(1)} = \alpha y_1 + (1 - \alpha)S_0^{(1)} = 0.99*100+0.01*100=100$$

$$S_1^{(2)} = \alpha S_1^{(1)} + (1 - \alpha)S_0^{(2)} = 100$$

By the formula (2), a_1=100, b_1=0, when t=2,

$$S_2^{(1)} = \alpha y_2 + (1 - \alpha)S_1^{(1)} = 0.99*108.6+0.01*100=108.51$$

$$S_2^{(2)} = \alpha S_2^{(1)} + (1 - \alpha)S_1^{(2)} = 0.99*108.51+0.01*100=108.43$$

By the formula (2), a_2=108.6, b_2=8.43
When calculates the predicted value in 1979, m=1,

By the formula (3), $\hat{y}_2 = a_1 + b_1 * 1 = 100$, $\Delta y_2^2 = \left(y_2 - \hat{y}_2\right)^2 = (108.6 - 100)^2 = 73.96$

Predicted value in 1980: $\hat{y}_3 = a_2 + b_2 * 1 = 108.6+8.43*1=117.03$

$$\Delta y_3^2 = \left(y_3 - \hat{y}_3\right)^2 = (112.8 - 117.03)^2 = 17.88$$

This moment, SSE=$\sum (y_t - \hat{y}_t)^2 = \Delta y_2^2 + \Delta y_3^2 \ldots\ldots + \Delta y_{36}^2$ =35374.6, a_{36} =3115.2, b_{36}=356.3,
Prediction equations:

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$$\hat{y}_{36+m} = 3115.2 + 356.3m \, (m=1,2,3,4\ldots\ldots)$$

When m=2, $\hat{y}_{38}$ is the prediction value of the second industry for 2015, by analogy, when m = 17, $\hat{y}_{53}$ is the prediction value of the second industry for 2030.

The prediction of the Industrial production index. Anqing city industrialization should spends ten more years entering the developed economic advanced stage, so we predict the Industrial production index in 2015-2030. Sets precision 0.01, through the exhaustive method we can infer that the best α is 0.99. $S_0^{(1)} = S_0^{(2)} = 100$, by the tabular data , $Y_1 = 100$, $Y_2 = 108.6$, $Y_3 = 109.4$, when t=1,

$$S_1^{(1)} = \alpha y_1 + (1 - \alpha)S_0^{(1)} = 0.99*100 + 0.01*100 = 100$$
$$S_1^{(2)} = \alpha S_1^{(1)} + (1 - \alpha)S_0^{(2)} = 100$$

By the formula (2), $a_1 = 100$, $b_1 = 0$, when t=2,

$$S_2^{(1)} = \alpha y_2 + (1 - \alpha)S_1^{(1)} = 0.99*108.6 + 0.01*100 = 108.51$$
$$S_2^{(2)} = \alpha S_2^{(1)} + (1 - \alpha)S_1^{(2)} = 0.99*108.51 + 0.01*100 = 108.43$$

By the formula (2), $a_2 = 108.6$, $b_2 = 8.43$

When calculates the predicted value in 1979, m=1, by the formula (3),

$$\hat{y}_2 = a_1 + b_1 * 1 = 100$$
$$\Delta y_2^2 = (y_2 - \hat{y}_2)^2 = (108.6 - 100)^2 = 73.96$$

Predicted value in 1980: $\hat{y}_3 = a_2 + b_2 * 1 = 108.6 + 8.43*1 = 117.03$

$$\Delta y_3^2 = (y_3 - \hat{y}_3)^2 = (109.4 - 117.03)^2 = 58.19$$

This moment, SSE= $\sum(y_t - \hat{y}_t)^2 = \Delta y_2^2 + \Delta y_3^2 \ldots\ldots + \Delta y_{36}^2 = 46390.3$, $a_{36} = 3351.7$, $b_{36} = 404.4$, Prediction equations:

$$\hat{y}_{36+m} = 3351.7 + 404.4m \, (m=1,2,3,4\ldots\ldots)$$

When m=2, $\hat{y}_{38}$ is the prediction of the Industrial production index for 2015, by analogy, when m = 17, $\hat{y}_{53}$ is the prediction value of the second industry for 2030.

The prediction results of the second industry and the industrial added value index of Anqing in 2015-2030(Table 5).

Table 5 The prediction table of the second industry and the industrial production index of Anqing

Year Indicators	2015	2016	2017	2018	2019	2020	2025	2030
The Second Industry Index	3827.7	4184.0	4540.2	4896.5	5252.8	5609.0	7390.3	9171.7
The Industrial Added Value Index	4160.5	4565.0	4969.4	5373.8	5778.2	6182.6	8204.8	10226.9

Through the predicted results it can be seen that the second industry and the industrial production index of Anqing continue to rise slowly in 2015-2030, based on the forecast analysis process, fitting degree of the actual value and the predictive value is high, they almost have the same change trend, so we can judge predicted results are reasonable.

Conclusions

In 2025-2030, the second industry and the industrial added value of Anqing will be doubled, and basically both have the same pattern of development. Although the GNP of Anqing is considerable, because the population base is too large, the GDP per capita is difficult to enhance, restriction from economic conditions limited the investment in technological innovation in Anqing, and lacking of funds has weakened the pulling power of high-tech economy. The widely accept concept of well education and relatively well-entrenched education system make Anqing be able to train a number of high-level talents. However, the poor economic situation leads to a continual brain drain. Petrochemical industry takes a large proportion of the overall city economy, the emerging high-tech industries are lack of stamina to develop. The whole strength of the industrial economy is weak, and vulnerable to the effects of large enterprises. In recent years, the decrease of petrochemical production, the overhaul of petrochemical facilities and the fluctuation of international crude oil prices also have a huge impact on the Anqing's economic, the achieve speed of expected above-scale industrial added value is slowing down significantly.

In addition, although the purpose of capital economic circle construction is to promote the province's economic rise, but now the core range includes only Hefei, Luan and Zhuzhou, the construction of the cities in capital economic circle will enlarge the gap between them and Anqing. The development of Anhui now focusing on the north, the development strategy of the city economic tends to move on to the north, government supports and good policies are less in southern cities.

Therefore, in order to enhance the city's economic and social development, we must focus on the development of the east and the industry-oriented development strategy, speed up the gathering and diffusion of various production factors, encourage industrial enterprises grown bigger and stronger, put forward incentive policies to leading enterprises which achieved certain targets or had better performance, enhance the exchanges and cooperation with other cities, encourage the development of foreign markets. Taking full advantage of geographic resources, transportation and mainstay industries, develop strong industry, enhance petrochemical, machinery, textile, medicine, building materials industry and actively developing other industrial projects, in order to promote coordinated economic development of regional economy.

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