



Medium and Long-Term Forecast of Shandong Economy under the Background of Conversion of New and Old Sources of Growth

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Abstract. Since the 18th National Congress, Shandong's economy has undergone profound changes. The GDP growth rate has fallen below the China's national average for the first time in many years. The output value of the tertiary industry exceeds that of the secondary industry, but it is more dependent on the development of manufacturing than the whole of China. The role of consumption as an economic stabilizer is prominent, and the net outflow of population and insufficient labor reserves make the significance of technological innovation even more important. Forecasts by two methods of production function model and labor productivity trend show that accelerating the conversion of new and old kinetic energy is both an important opportunity and a challenge for Shandong's economic growth.

Keywords: Economic forecast; old and new drivers; Shandong.

1 Introduction

The international economic crisis combined with the unbalanced domestic economic growth and structural problems, the "old normal" of the high-growth, extensive and low-cost-driven economy is unsustainable. China's economy has entered a period of shifting growth rates, a period of structural adjustment pains, and a period of digestion of previous stimulus policies. This state is officially defined by China as the "new normal". As a cognition of the current state of development, it is an important basis for judging future growth trends and formulating countermeasures. Since 2014, General Secretary Xi Jinping has emphasized the new normal of economic development on many occasions and pointed out the characteristics of the new normal of economic development. In summary, there are three main characteristics: first, the growth rate is shifted, and GDP is adjusted from high growth to medium and high speed; second, structure Optimization, increasing the proportion of the service industry, increasing the international competitiveness of high-end manufacturing, narrowing the urban-

rural and regional gap, and increasing the proportion of residents' income; the third is the transformation of power, which drives economic growth from factors and investment to innovative capabilities.

On January 20, 2017, the General Office of the State Council issued the "Opinions on Innovative Management, Optimizing Services, Cultivating and Growing New Drivers of Economic Development and Accelerating the Conversion of New and Old Drivers", which is China's first document on cultivating new drivers to accelerate the conversion of new and old drivers. Taking advantage of the situation, Shandong Province submitted the "General Plan for the Construction of a Comprehensive Experimental Zone for the Conversion of New and Old Kinetic Energy in Shandong" to the State Council at the end of 2017, which was approved on January 3, 2018. 2018 is the first year for Shandong Province to accelerate the conversion of new and old kinetic energy. According to the "Implementation Plan for Major Projects for the Conversion of New and Old Kinetic Energy in Shandong Province", the overall plan will be implemented for at least 10 years and will last until 2028. It is expected that the conversion of new and old kinetic energy will be basically completed by then. Judging from international experience, the economic transition period of Japan and South Korea lasts for 15-20 years, and the national new normal is expected to last until at least 2025. Therefore, the basic completion time of the new and old kinetic energy in Shandong Province is basically the same as the completion time of the new normal.

2 Typical Facts about the Conversion of New and Old Kinetic Energy

2.1 GDP Growth Rate Dropped below the National Level

Shandong's GDP growth trend is roughly similar to that of the national GDP. After nearly a decade of rapid growth and after the GDP growth rate fell into a trough during the international financial crisis, the growth rate entered the "last 10%" stage after 2012. In the new stage of economic growth, Shandong's GDP growth rate continued to decline, and fell below the national level for the first time in 2018, which shows that Shandong's economy has undergone profound changes ^[1].

2.2 The Proportion of the Tertiary Industry Exceeds that of the Secondary Industry, but the Manufacturing Industry Still Plays an Important Role

In 2016, Shandong's tertiary industry accounted for more than the secondary industry's GDP, and the tertiary industry's GDP contribution rate exceeded 50%, indicating that Shandong's economy has entered the service economy era. However, compared with the whole country and Jiangsu province, Shandong's tertiary industry accounts for a low proportion of GDP ^[1]. For example, in 2020, it was 0.9 percentage points lower than the national average. Moreover, the proportion of tertiary industry surpas-

sing the secondary industry lags behind the country by four years. It shows that Shandong's economy is still relatively dependent on industrial development.

Within the industry, the proportion of manufacturing value added has remained above 80%, of which it was 83.4% in 2020; since the new normal, the proportion of value added by the mining industry has decreased, from 9.8% in 2012 To 6.6% in 2020; the proportion of added value in the production and supply of electricity, gas and water increased, from 2.7% in 2012 to 10.0% in 2020. At the same time, the internal structure of the manufacturing industry has also been continuously optimized, the proportion of the added value of high-energy-consuming industries has continued to decline, and the proportion of the added value of the equipment manufacturing industry has shown an upward trend.

2.3 The Role of Consumption Stabilizer Is Prominent, and the Role of Scientific and Technological Innovation on Economic Growth Has Increased

From the perspective of demand, since 2010, Shandong's fixed asset investment, total retail sales of consumer goods, and exports (calculated by export destination) have shown an overall downward trend. Among them, the growth rate of fixed asset investment continued to decline from more than 20%, and fell to less than 3.6% at the end of 2020, a record low; the growth rate of total retail sales of consumer goods in the whole society continued to decline, from more than 18% to 0%, a decline Lower than investment in fixed assets; the export growth center has moved down significantly, but the growth rate fluctuates greatly, mainly because the international economic situation is more uncertain. In short, consumption has increasingly become the main force for stabilizing economic growth (figure 1).

Overall, on the one hand, the population growth rate and structure have undergone major changes. The natural population growth rate is higher than the national level, but the growth rate has once again entered the downward channel after the short-term stimulation of the "two-child policy". Since the new normal of economy in China, the growth rate of the permanent population has been lower than the natural population growth rate in most years, indicating that Shandong's transition from a net population outflow to a net population outflow is the result of two factors: rapid population growth and economic downturn. The proportion of the population has been declining and fell to 66% in 2019. The labor reserve is increasingly insufficient; the proportion of the urban population is higher than the national level and exceeded 63% in 2020. It is still in the rapid squeezing stage of urbanization. It is a macroeconomic an important engine of growth. On the other hand, the number of patents granted and the number of high-tech enterprises in Shandong Province still maintains rapid growth, and the role of technological innovation in driving economic growth has increased (figure 2 and 3) [2-5].

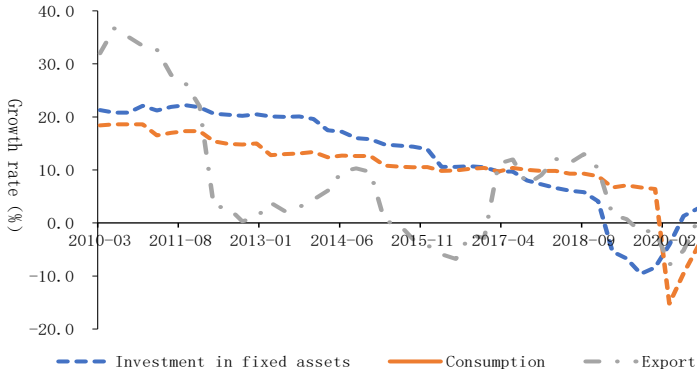


Fig. 1. The quarterly growth of investment, consumption and export in Shandong (Source: self-painted)

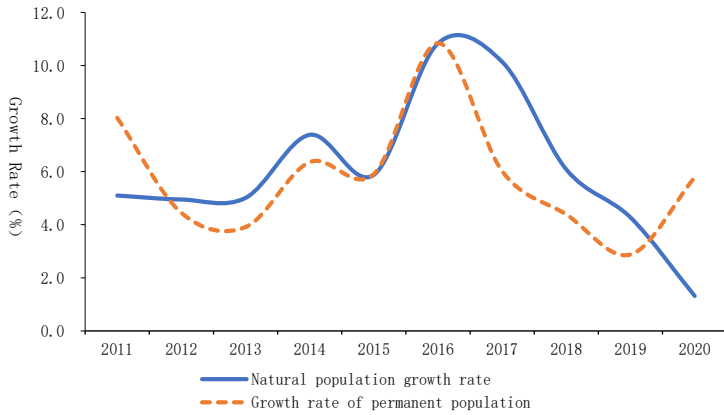


Fig. 2. Population growth in Shandong (Source: self-painted)

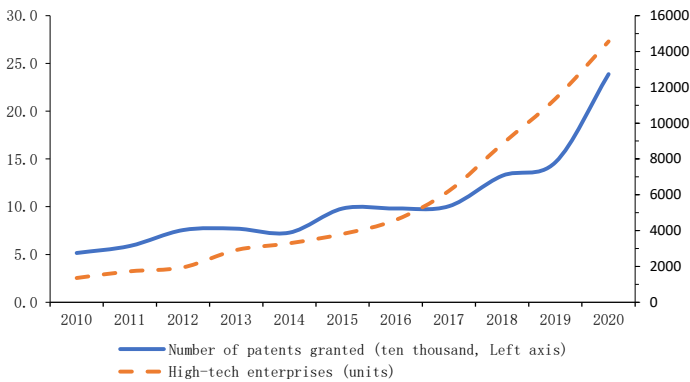


Fig. 3. Science & technology and application situation (Source: self-painted)

3 Medium and Long-Term Economic Growth (2021-2040) Forecast

This article forecasts the macro economy of Shandong Province from 2021 to 2040, mainly using economic growth function and labor productivity method for analysis and forecasting.

3.1 Cobb-Daugglass Function Method

Method Introduction. The C-D production function model assumes that there are only two production factors, labor and capital, in the economy, and the two production factors can replace each other. The basic form of the C-D production function is:

Among them, represents output, represents technological progress, represents capital input, represents labor input; is the output elasticity of capital, and is the output elasticity of labor. If represents constant returns to scale; represents increasing returns to scale; represents diminishing returns to scale. In the empirical study of China's production function, it is generally assumed that the economic system is constant returns to scale, which means that if capital and labor increase by the same multiple during the production process, total output will also increase by the same multiple.

The Cobb-Douglas model can predict the medium and long-term economic development level of each province. This model adopts the assumption of constant returns to scale, and attributes factors affecting economic growth other than capital and labor to technological progress.

The labor force uses the total number of employment in the three industries in Shandong Province, and the capital stock is obtained from the fixed asset investment (constant price in 1978) in Shandong Province through depreciation and accumulation. Among them, the research of Shan Haojie, Zhang Jun and others was referenced from 1987 to 2012. Technological progress adopts Shandong Province's research and development funding input. The sample time is from 1987 to 2020, and the data comes from the Wind Information Database and the "Shandong Statistical Yearbook" over the years. The common expressions of this model are as follows:

$$Y = A(t)K^\alpha L^\beta T^\theta \mu (A > 0, 0 < \alpha < 1, 0 < \beta < 1, 0 < \theta < 1, \mu \leq 1) \quad (1)$$

Among them, the Y, K, L, and T sub-tables represent GDP, capital, labor, and technological progress input, represent the technological level, and t represents the year, so A(t) represents the coefficient of technological progress. α, β, θ Respectively represent the elastic coefficients of capital, labor, and technological progress to GDP, and set $\alpha + \beta + \theta = 1$. After logarithmic processing, the model is obtained:

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L + \theta \ln T + \mu \quad (2)$$

The analysis and prediction process of the C-D model can be divided into four main steps: (1) Construct the econometric regression model of Shandong Province based on the sample data from 1987 to 2015; (2) Estimate the variable parameters of labor, capital, and technology; (3) Assume that the output elasticity of capital and labor

remains unchanged during the forecast period; (4) Predict the medium and long-term GDP growth rate of Shandong Province, based on the trend of technological progress, capital, and labor.

Method Application. The data used include actual GDP, capital stock, labor force and patent applications (substitute for R&D investment). Among them, the actual GDP is based on the sequence of 1978; the capital stock is calculated using the perpetual inventory method based on 1978; the number of labor is the sum of the employment in the three industries.

The medium and long-term forecast of Shandong’s GDP needs to be considered in advance of the future growth of Shandong’s capital stock, labor force, and technological progress. The specific setting is based on the stage of Shandong’s economic and social development (such as in the late stage of industrialization, rapid urbanization) at the end of the rising stage, per capita income level comparison, etc.), as well as the historical trends of these variables.

Based on the recent situation of Shandong Province accelerating the conversion of new and old kinetic energy [6-9], based on the Cobb-Douglas model, forecasts are based on three scenarios: baseline, slow conversion of new and old kinetic energy, and accelerated conversion of new and old kinetic energy. Under the three scenarios, the economic production efficiency of Shandong Province is in order of the benchmark scenario, the acceleration scenario, and the slowdown scenario (table 1 below).

Table 1. Medium and long-term forecast of Shandong GDP (2021-2040) % (Source: self-calculation)

	Growth rate (base-line)	Growth rate (acceleration)	Growth rate (slowdown)
2011-2015	9.4	9.4	9.4
2016-2020	7.0	7.2	6.9
2021-2025	6.3	6.5	6.0
2026-2030	5.4	5.8	5.1
2031-2035	5.0	5.2	4.8
2036-2040	4.5	4.8	4.2

3.2 Labor Productivity Law

Principle Description. Assuming that the total economic output value of an economy in a certain period of time t is Z (t), from the perspective of laborers using the means of production to produce value, the total economic output value is the product of the number of laborers X (t) and labor productivity Y (t), That is, Z (t) =X (t)*Y (t). According to the data principle, the growth rate of a variable is equal to the derivative of the time t after the variable takes the logarithm, then the following formula holds:

$$\frac{\dot{Z}(t)}{Z(t)} = \frac{d \ln Z(t)}{dt} = \frac{d \ln[X(t)Y(t)]}{dt} \tag{3}$$

Because the logarithm of the product of two variables is equal to the sum of the logarithms of the two variables, therefore:

$$\frac{\dot{Z}(t)}{Z(t)} = \frac{d \ln X(t) + dY(t)}{dt} = \frac{d \ln X(t)}{dt} + \frac{d \ln Y(t)}{dt} = \frac{\dot{X}(t)}{X(t)} + \frac{\dot{Y}(t)}{Y(t)} \quad (4)$$

That is, the growth rate of the total economic output value $Z(t)$ is equal to the sum of the respective growth rates of the number of laborers $X(t)$ and labor productivity $Y(t)$. Because labor productivity fluctuates greatly in the short term, and the employment rate (or unemployment rate) will also fluctuate due to changes in the business cycle, this method is more suitable for predicting and analyzing medium- and long-term economic growth rates to show economic growth potential. This method is highly practical and is mainly based on predicting the trends of labor productivity and labor supply.

Method Application. Combined with the number of labor force in Shandong Province, labor productivity, population growth forecast in Shandong Province, and labor productivity forecasting method, a phased forecast for 2021-2040 is made.

The labor force in Shandong Province is expected to reach its peak in 2035, and the total labor force will decline thereafter. At the same time, the average annual growth rate of the labor rate will decline steadily. The average annual GDP growth rate in 2020, 2025, 2030, 2035, and 2040 is expected to be 7.8% and 7.1%, 6.2%, 5.7%, 5.5%. Compared with the prediction of the Cobb-Douglas model, the prediction result of the labor productivity method is higher.

4 Conclusions

The economy of Shandong Province has undergone profound changes since it entered the new normal. Through the production function measurement model and the development trend of labor productivity, the GDP growth rate of Shandong Province from 2021 to 2040 was predicted. The forecast results show that the average annual growth rate of GDP in the “13th Five-Year Plan” is 7.3%, which is 0.2% lower than the target of the “Thirteenth Five-Year Plan”, and enters the growth rate of “6% in the 14th Five-Year Plan” and “15th Five-Year Plan” respectively. In the “5%” stage, it is expected that the GDP growth rate will be relatively stable in the later period due to the enhanced role of new kinetic energy.

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