Research on Modern Higher Education 2, 01019 (2017)
DOI: 10.24104/rmhe/2017.02.01019


# Viewing the strategic development of China's industrial construction based on the experience of Germany

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ABSTRACT: China's industrial construction has several problems and the experience of German industrialization can inspire China significantly to come out with the solutions. Based on the case study of Ruhr, this paper makes comparison between the industrial construction of China and Germany, and also proposes several suggestions to speed up the construction of China's industrial power including infrastructure, policies, introduction of foreign capital, and promotion of scientific research and education investment.

*Keywords*: industrialization; China; Germany; case study

## 1 CURRENT SITUATION AND PROBLEMS OF CHINA'S INDUSTRIAL CONSTRUCTION

Since the start of industrialization process in China in 1950s, the development process has experienced twists and turns. Especially after the reform and opening up, it has been 30 years since China started its rapid economic growth. The GDP per capita rose from less than $100 in 1978 to more than $4000 in 2011, which has turned China into second largest economy in the world. China is in the middle stage of industrialization at present, which means that China is in the transformation stage from a big industrial country to a powerful one.

### 1.1 *Current Situation*

#### 1.1.1 *The economy is huge and the industry is growing fast*

China has a large volume of economic aggregate, which ranked sixth in the world in 2000. After taking place of Germany, the third largest economic body in the world, China's GDP has reached 39.8 trillion yuan and surpassed Japan to become the second largest economic body. Facing up to the financial crisis in a comprehensive way, Chinese government enacted and promulgated ten industrial restructuring and revitalization planning timely, which has placed an important role in stabilizing and maintaining the smooth and quick development of the national economy. During the "Eleventh five year", the average annual growth of industrial value has reached 11.3%, the national urban industrial enterprises investment amounted to an average annual growth of 26.1%, and the industrial enterprises larger than state designated scale have achieved a total profit with an average annual growth of 30.2%. By 2010, the whole industrial added value has run up to 16 trillion yuan, accounting for 40.2% of the GDP. Moreover, the investment in national urban industrial enterprises has been 9.9 trillion yuan, and the industrial enterprises larger than state designated scale have achieved a total profit of 4.2 trillion yuan.

#### 1.1.2 *Industrial economic performance works well, and energy saving and emission reduction have significant results*

Light industry is relatively stable, while the growth of heavy industry has slowed down. Take 2010 for example, light industry has increased by 13.6%, accelerating 3.9% year-on-year. Efforts were intensified to save energy and reduce emission; the productivity growth momentum of high energy consumption industry has been contained. In 2010, the added value of six high energy consumption industries increased by

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13.5% all the year round, which falls back by 3.7% and 1.3% compared with that of the first half year and the first three quarters of 2010. The growth rates in last four months of 2010 are all under 10%. The smelting and rolling processing industry of ferrous metal and non-ferrous metal have increased by 11.6% and 13.2% respectively, falling back by 2.1% and 2.2% compared with the first three quarters. Production and supply of electric power has increased by 11%, falling back by 1.8%. Chemical raw materials and chemical products manufacturing, oil processing and coking and nuclear fuel processing industry have increased by 15.5% and 9.6% respectively, falling back by 1% and 0.4%. Manufacturing of non-metallic mineral products has increased by 20.3%, which is basically balanced with that of the first three quarters.

#### 1.1.3 *Continuous increase of the exports of industrial products*

The industrial export value reached 9.1 trillion yuan in 2010, up 25.4% from a year earlier and increasing by 12.7% compared with that of 2008. Thereinto, the export value was at an all-time high stage in December and has reached 866.3 billion yuan, increasing by 18.3% year on year. According to the statistics of customs, China's foreign trade export amount was 1.5779 trillion dollars in 2010, increasing by 31.3% year on year, up 10.5% from 2008. And it worthwhile to note that it has increased by 17.9% in December.

#### 1.1.4 *The industrial investment increases steadily*

In 2010, the industrial investment of the urban fixed asset investment has reached 9.8716 trillion yuan, increasing by 22.8% year on year, falling back by 3.4% compared with that of last year. The proportion of industrial investment in the urban fixed asset investment was 40.9%. The manufacturing investment was 7.4528 trillion yuan, increasing by 27%, accelerating by 0.2% from the last year. In December, the industrial investment has increased by 23.4%, falling back by 3.4% compared with that of last month. The investment of the energy intensive industry increased range recedes largely. The investment of the six energy intensive industries made in 2010 was 3.4754 trillion yuan, increasing by 14.8%. The increased range fell back by 7% year on year. Thereinto, the investments of non-metallic mineral products, chemical raw materials and chemical products manufacturing have increased by 28% and 14.8% respectively, falling back by 15.5% and 12.2% year on year. The investments of the industry of oil processing and coking, nuclear fuel processing industry, industry of non-ferrous metal smelting and rolling processing have increased by 12.9% and 35.8% respectively, increasing by 12.5% and 19% year on year. The investment of ferrous metal smelting and rolling processing industry has increased by 6.1% while it fell by 1.3% in the last year. And the investment of electricity, heat production and supply industry has increased by 6.6%, falling back by 16.2% compared with that of last year.

### 1.2 *The problems*

#### 1.2.1 *The industry amount is large but not strong*

From the perspective of economic aggregate and the development of industry levels, China has been an “industrial power”. Actually, China’s condition is big but not strong. "Big" describes the size and number, and the "strong" is to illustrate the efficiency and quality. Our country’s industrial structure needs to be transformed and upgraded. From the point of the international industrial division, our country is still at the low end of production chain. We lack large multinational companies with international competitiveness in terms of scale and technical level. The industrial production technology level and the research and development ability have a larger gap with the advanced level. The labor productivity is low. And technology-intensive products exported with high added value have a low proportion in all export products.

#### 1.2.2 *The industry has obvious structural contradictions and is lack of international competitiveness*

The industrial enterprises in our country have problems of small scale, complex structure, disordered distribution and lacking reasonable development plans. From the aspect of product structure, our country is short of the high technology content of products and the added value of the existing industrial is low. It does not only waste social economic resources and reduce the economic benefit of enterprises, but also affects the competitiveness of the products and intensifies the contradiction of supply and demand in the domestic market. Moreover, the industrial structure with high similarity and repeated construction is common. The similarity rate of industrial structure in central and eastern China was 93.5% while the similarity rate in western and central China was 97.9%. There is a problem of convergence of industrial structure in all regions of the country.

#### 1.2.3 *The high and new technology industry is relatively weak*

Although the high and new technology industry has developed rapidly, the process of development still has many problems and the development power is weak. The processing and assembly of industrial products still accounts for large proportion and the added value of industrial products is low. The situation of big scale but weak power has not changed fundamentally. As a whole, the innovation ability of enterprises is still weak and enterprises grasp less key technologies. The high-level innovative talents are relatively deficient. Our country needs to establish a diversified investment mechanism in long-term. In-

dustrial sustainable development is underpowered. The policies matching with high and new technology industry development also need improvements.

#### 1.2.4 *The combination of industry, university and research is yet to be improved*

The combination of industry, university and research is still in a low level. The combination modeled by market demand is only limited to technology transfer, development, services, consultation and other aspects. It has little effect outside the market and the mode of cooperation level needs to be improved. Compared to the foreign diverse cooperative mode, including cooperation center, research institutions, science parks, the combination mode in our country is relatively single. The connection and labor division of the units in the combination mode are not clear enough. As it always uses the administrative means rather than the market mechanism, the relevant agencies are large in scale but the division of labor is vague.

## 2 CONSTAST OF TYPICAL COUNTRIES: GERMAN INDUSTRIALIZATION PROCESS

### 2.1 *German industrialization process*

Compared with countries such as Britain, France, and the United States, Germany's industrialization started much later. In the initial stage of the industrial revolution, Germany's politics are divided and the economy was relatively backward. However, it developed very quickly in a short time. Germany realized industrialization, caught up with Britain and France and was neck and neck with the United States. It resulted from choosing to reform and this led to the hopping growing state of industrialization. Germany's industrial development can be roughly divided into following three stages.

The initial stage (1835-1850): the sign of Germany's industrialization was the success of the first railway construction from Nuremberg to Furth in 1835. It led to all-round development of industrialization in Germany more quickly than the traditional textile industry. Railway construction played a direct and significant role in promoting other industries because of the demand for steel and locomotives in the railway construction; it greatly stimulated the development of the steel, coal and the machine-building industry in Germany.

The breakthrough stage (1850-1871): from Prussia constitution was promulgated in 1850, the economic development had been a compulsory force. The large scale industrial revolution determined the direction of industrialization. And the coal, steel, steam hammer and gear became the basis for industrial production. Industrial development had brought great driving force to economic growth. Mining and metallurgy of iron and steel industry had become the dominant industry. This breakthrough stage lied in the development of machinery industry, and the textile and cotton spinning industry realized full mechanization. From 1850 to 1870, The GDP has doubled and the share of all departments has changed a lot. Germany began the road towards modern industrial country.

The take-off stage (1871-1913): German Empire was established in 1871, which promoted the development of new technology revolution and economy. Germany came into the era of electrical industry quickly. In 1870-1913, the value of heavy industry expanded by 7.5 times. The production of coal, iron and steel expanded by 7.2 times, 12.9 times, 107 times respectively. The length of railway had increased from 2.12 kilometers to 6.37 kilometers in 40 years since it implemented "nationalization" in 1873. Machinery manufacturing grew so fast that there was no country could match Germany. Germany caught up in the three emerging industrial sectors: chemical, electrical, optical industrial. Germany launched a challenge to UK in the chemical industry and a challenge to the United States in electrical industry. And high quality products of optical industry were nearly one hundred percent from Germany.

### 2.2 *Typical case analysis: the problems and the policy response in the process of the Ruhr industrial development*

#### 2.2.1 *The basic situation of the Ruhr*

The Ruhr is one of the most important industrial areas in Germany and largest economic zones in European. It is not an independent administrative division, but an urban agglomeration composed of NRW 11 municipalities directly under central government and 4 county-level cities. It is located in the western of Germany, north Rhine-Westphalia state, including the Ruhr River, the Emscher River, the Lippe River and the downstream region of the Rhine River. The formulation of the Ruhr first appearing in the official document is the Treaty of Versailles signed at the end of the First World War.

The Ruhr now has become an area mainly on services and high-tech. The main task of the area is to form new economic development strategies and industry networks. The Ruhr is an industrial cluster having a great potential in various industries, including chemical, energy, health care services, information and communication technology, industrial technology and materials, logistics, engineering, tourism, culture and design industries, etc.

The Ruhr is rich in natural resources. The geological reserves of the coal are 219 billion tons, accounting for three-quarters of Germany's total reserves. And the economic recoverable reserves are about 22 billion tons, accounting for 90% of the country. What's important, the Ruhr is the high quality hard coal field having many coal ranks and good quality coal. All of

the coal mines have the iron ore layers, including siderite, black iron ore and iron ore.

2.2.2 *The industrial structure evolution of the Ruhr*

With the development of the industrial revolution, coal industry in the Ruhr got rapid development. The production was monopolistic in the former West Germany's energy structure. The demand focal and its derivatives increased rapidly in iron and steel industry and chemical industry, so the Ruhr's coal sales were rising. Meanwhile, the iron and steel industry developed fast in the Ruhr. In the 1950s, its steel production accounted for 30% of the output of the European Economic Community.

The industrial development of the Ruhr had taken place major changes before and after 1950. It was mainly affected by the low cost of coal in external environment and other areas. The coal industry of the Ruhr had declined since the 1970s. Compared with cheap coal in other places, the coal resources of the Ruhr were deep burial, which is difficult for drilling and in high cost. With the technology progress and development of global iron and steel industry, the steel demand of the Ruhr reduced. Some iron and steel industries were transferred to the regions where had lower cost of production. Therefore, the iron and steel industry had started to shrink in the Ruhr.

The change of the Ruhr industrial development can be seen from the change of its employment structure.

Table 1. The changes in the Ruhr's employment structure

| | 1960 | 1970 | 1980 |
|---|---|---|---|
| Population( ten thousand) | 570 | 570 | 540 |
| Coal industry workforce (thousand) | 653 | 418 | 325 |
| The proportion of workforce in coal industry in the population (%) | 11.5 | 7.34 | 6.02 |
| Workforce in iron and steel industry (thousand) | 1037 | 862 | 721 |
| The proportion of workforce in iron and steel industry in the population (%) | 18.2 | 15.1 | 13.4 |

2.2.3 *Three stages in the construction*

In response to rapid declining, the Ruhr began to carry out transformation in industrial economy with the support of European Union, central and local government. The reconstruction mainly experienced three stages.

The stage of defensive reconstruction: during this time, it was generally believed that the crisis was temporary. The Ruhr development plan mainly on defense came out in 1968. It supported the traditional industries which had a recession trend. The Ruhr kept the traditional regional economic structure by expanding investment and production scale, improving the production capacity to maintain production ability and competitiveness.

The stage of offensive reconstruction: after 1984, the Ruhr government realized that it was difficult to effectively revitalize the Ruhr industry by relying on the past economic structure after making an attempt at the defensive reconstruction. The government began to reform the traditional pillar industries, optimize product structure and update production technology in order to upgrade the products. The government also used the intellectual resources to strengthen the scientific research, implemented the diverse industrial strategy and developed new industries vigorously.

The rebuilding stage of promoting diversified industrial structure by developing competitive industries: in the late 80s, the Ruhr continued to develop competitive industries in order to advance structural diversity and promote the industry reconstruction. In 1989, the government enacted the future agreement of the mining area. Then the Ruhr implemented the European Union and north Rhine-Westphalia coalition plan. In the approach of giving full play to the geographical advantage, the Ruhr formed the advantage industry with local characteristics in different regions and promoted the diversification of industrial structure.

2.3 *The main achievements of the transformation*

After the transformation more than 40 years, the Ruhr had obtained the remarkable results in the economic development. It has great adjustment of the industrial structure. Through the transformation of the old industry promoted by informationization and developing production-oriented enterprises using a technical design park as the new carrier, the Ruhr gradually transformed from Germany's coal and steel manufacturing center to a new comprehensive economic zone. The new Ruhr was based on the coal and steel. It was mainly on the new and high technology industries and various industries attained coordinated development. The Ruhr mainly had the following achievements in the industry transformation.

A new industrial foundation supported by high and new technology was formed. Most of the enterprises established scientific research institutions. According to the characteristics of enterprises and market, they set own scientific research plans closely combined with the production. And the Ruhr had carried out the comprehensive reform of traditional industries, established information center of innovation of science and technology and helped the enterprise make technical reform plans. It greatly accelerated the steps of transforming scientific researches to productive forces.

Traditional industry structure is transferred to diversified structure. The Ruhr's economic structure had been enriched and enhanced through a series of structural adjustments. In terms of the industrial structure, the proportion of the traditional coal and steel industry dropped sharply and the output value accounted for only 16% of the whole industrial value. And from the point of employment structure, the proportion of the staff in coal and steel departments also declined from 60% in the 50s to 33% in the 90s.

Table 2. The related policy of construction in the Ruhr

| Stage of development | Time | The name of the policy | The content of the policy |
|---|---|---|---|
| First stage | 60s | Reindustrialization policy | Under the premise of keeping the traditional regional economic structure, implement reindustrialization. In the face of the Ruhr industrial decline trend as well as the world's coal and steel market shrinking, maintain production ability and competition ability by increasing investment, expanding production scale and improving production capacity. |
| | 60s | Common task to improve regional economy | To determine the central task is to promote the formation of industrial capital and emphasize the export industry. Make the life level more consistent in all parts of the German. |
| | 1968 | The Ruhr development compendium | To make coal mining industry focus on more profitable and high mechanization level of mine. |
| Second stage | After 1984 | The new industrial district plan | Drive the technical innovation to the traditional pillar industries.<br>Use the intellectual resources to strengthen scientific research and development.<br>Implement the strategy of industrial diversification.<br>Develop the emerging industry, such as the IT industry. |
| | 1985 | The economic transformation policy | Set up the science and technology park: divided into five stages since 1985, invest 130 million mark to build a park.<br>Develop the handicraft industry and small and medium-sized enterprises.<br>Vigorously develop productive enterprises<br>Develop the service sector; |
| | 1986 | Set up labour bureau and council for the promotion of economic | Set up labor bureau and council for the promotion of economic. Strengthen the cooperation between the government and economic circles and trade unions, and promote the economic development and increase employment. |
| Third stage | 1989 | "the future agreement of the mining area" and "the European Union and North Rhine-West Phalia coalition plan" | Further promote the development of characteristic industry, promote the diversification of industrial structure, and give full play to the advantage of the Ruhr area. |
| | 1985 | New industrialization policy | Promote the adjustment of employment structure with the adjustment of industrial structure.<br>Establish the strategy of transforming traditional industries by informatization and drive transformation of the traditional industry by information technology.<br>Vigorously develop the cultural creative industries. |

The enterprises stepped into the road of miniaturization. After a series of adjustments, regional enterprises increased numerously and the scale of the enterprises turned to miniaturization. Compared with 1980-1985, the start-ups in the Ruhr increased by 41% and the business failures accounted for 21% of the total number of enterprises from 1985 to 1988.The start-ups were mainly small and medium-sized enterprises. It balanced the regional economic structure as well as further enhanced the regional economic vitality.

Regional spatial structure had been further optimized. The traditional industry department and emerging industrial sectors had changed rapidly since the internal markets of EU member being developed in the early 1990s. The Ruhr realized the outward transfer of traditional industries and inward transfer of emerging industries with its geographical advantages and industrial base. It made the Ruhr's spatial structure further optimized.

The quality of cultural life was improved by promoting new industries which specialized in creative culture and tourism. Through preferential policies, it significantly achieved economic structure adjustments, environment improvements and development of creative cultural industries and leisure tourism. The Ruhr transformed from a severe polluted industrial districts not suitable for life to a paradise.

## 3 SUGGESTIONS TO SPEED UP THE CONSTRUCTION OF INDUSTRIAL POWER

### 3.1 *Strengthen the construction of infrastructure and improve the policy environment*

Based on current situation, the government should put forward new goals and policies timely, make scientific overall development plans and strengthen the construction of infrastructure to provide a basis for industrial development. Meanwhile, it's important to create a good development environment for active investment and break the original policy limit. Moreover, according to the present situation of industrial development in everywhere and the characteristics of development, policy should be researched to promote the development of industry and more breakthroughs should be strived in the industrial agglomeration, base construction, the development and construction of industry union, independent innovation and tackling key technical problems.

### 3.2 *Speed up the transformation and upgrading and promote industrial diversification*

The government should vigorously support the industrial innovation and the highly effective cooperation between the enterprises and national scientific research institutes, and promote the development of new industries. More attention should be paid to the transformation of traditional industries, and we should actively adopt new technologies, new technologies and improve product competitiveness. As for leading backbone enterprises, a good development model should be formed to promote learning and independent innovation capacity of advanced knowledge and technology in the world. The government should rectify the traditional industry, adjust the industrial structure, improve the technology content and set the threshold to eliminate the high pollution and low yield enterprises.

### 3.3 *Introduce foreign capital and technology and widen the horizon of opening up*

In the accelerating transformation of the old enterprises, it needs to vigorously support emerging industries. Increase the intensity of opening up, actively create conditions for the introduction of foreign capital, and promote the development of emerging industries such as information technology industry and biotechnology industry in order to increase transforming power of the old industrial area. Accelerating the introduction of advanced technology and promoting the industrialization of the advanced technology can lead to the development of relevant industries and create more working opportunities, thus promoting the stable development of the society.

### 3.4 *Implement ecological environment protection and change the regional image*

The government should make overall plans for reasonable layout of the construction of regional ecological environment. A long-term planning and development strategy of environmental cooperation should be made. We should also strengthen the cooperation and coordination of regional environmental governance and improve the regional development environment. Also establishing unified standards for environmental protection and planning would be great. The government should strengthen the construction of environmental monitoring network and improve the law enforcement mechanism of the environmental protection as well. Moreover, the government can set up a scientific system of ecological compensation mechanism and risk management.

### 3.5 *Increase scientific research and education investment and improve the productivity*

It needs to further strengthen the work in the strategic research, making major decisions research, education practice research, theoretical research, the construction of scientific research team and innovation ability training, etc. The government should improve the education scientific research management institutions and working mechanism as well as the investment in education scientific research funds. The construction of education scientific research teams needs to be strengthened, and the transformation of advanced foundation to productivity should be promoted.

## ACKNOWLEDGEMENT

This research is financially supported by the National Natural Science Foundation of China (Grant No. 71473229), the key National Natural Science Foundation of China (Grant No. 71132007) and Zhejiang Provincial Natural Science Foundation of China (Grant No. LQ14G030024).

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