

How Industrial Policies Guide Industrial Restructuring and Economic Development: From Coal to Semiconductor

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Abstract:

This paper examines the role of industrial policies in guiding industrial restructuring and fostering economic development, using the historical economic trajectories of Japan, South Korea, Germany, and Ireland as case studies. The analysis spans from the post-World War II era to the present, highlighting the strategic shifts from coal and steel production to semiconductor and information technology industries.

Keywords: component; formatting; style; styling; insert

1. Introduction

The aftermath of World War II presented a dire economic landscape for many nations. However, a few countries not only recovered successfully, but also became the world's highest income countries (Figure1). Economic Development include two criteria: one is per capita income, that is, developed

countries always have higher per capita GDP(World Bank,2020); the other is industrialization, that is, the tertiary industries are the dominant industries in developed countries (United Nations Industrial Development Organization, 2016). The Figure2 shows the per capita income of Japan, South Korea, Germany and Ireland between 1960 and 2020.

| | Low Income | Low-middle Income | Upper-middle Income | High Income |
|---------------------------|------------|-------------------|---------------------|-------------|
| July 1,2024-for FY25(new) | ≤1,146 | 1,146 - 4,515 | 4,516 - 14,005 | ≥14,006 |
| July 1,2023-for FY24(new) | ≤1,135 | 1,136 - 4,465 | 4,466 - 13,845 | ≥13,845 |

Source: World Bank Group-Figures in United States Dollar (US\$)

Fig 1: Country Classification by Income Level (From: World Bank)

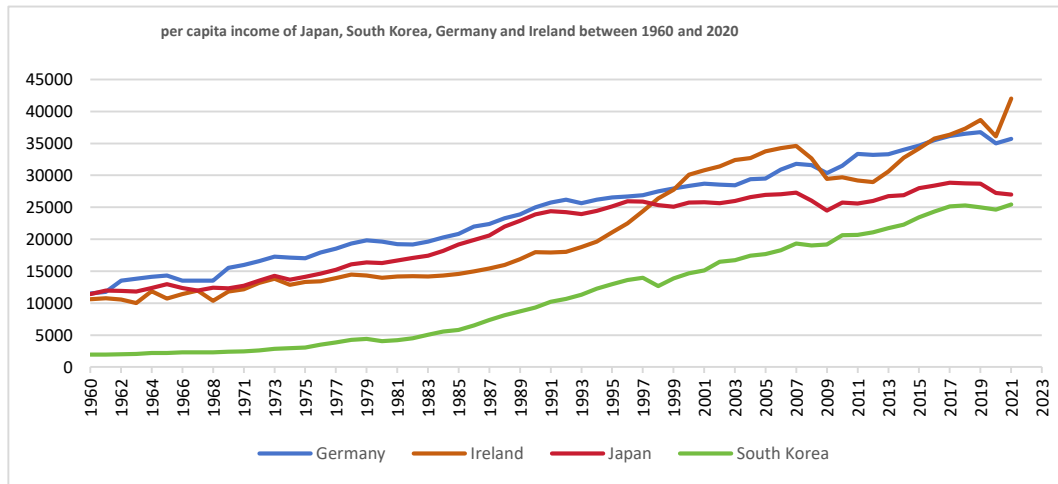


Fig 2: per capita income of Japan, South Korea, Germany and Ireland between 1960 and 2020

2. Classification Criteria

Based on the Chenery Industrialization Stages classification standard (Chenery & Syrquin, 1980)(Figure3), this paper explores the differences in policies for the development of the primary industry (agriculture), secondary industry (textiles, steel and machinery manufacturing),

and tertiary industry (electronic information services industry) in various countries (Fischer, 1935), as well as the economic impacts they bring, and the impact on per capita GDP, proving that industrial restructuring policies are beneficial to economic development in the short term (over a period of 20 years).

| Stage | Per capita income (1970 US\$) |
|-----------------------------------|-------------------------------|
| Primary production stage | 140-280 |
| Early stages of industrialisation | 280-560 |
| Mid-industrialisation stage | 560-1120 |
| Industrialisation maturity stage | 1120-2100 |
| Developed economic stage | 2100-3360 |
| | 3360-5040 |

Source: H.Chenery(1986).A Comparative Analysis of Industrial Growth

Fig 3: Chenery Industrialization Stages classification standard

Industry restructuring is generally used to characterize a country or region adjusting and reorganizing its existing industrial proportions through policy guidance (Simonis, 1994). Industrial restructuring aims to shift the focus of economic growth from speed to quality and efficiency. However, the per capita income is affected by exports (Anwer & Sampath, 2000), foreign economic aid (Resnik, 2006) and education (O'Malley, 1992).

This paper selects four countries with similar levels of foreign aid, educational development, and export trade, and compares Japan and Germany as one group and South Korea and Ireland as another group according to their industrial restructuring policies and development. According to the Kuznets cycle(Kuznets, 1971),

the long-term fluctuations that exist in the economies of major capitalist countries have a duration of approximately 15 to 25 years, so it is divided into three parts according to the key development industries in three periods(1960-1980,1980-2000,2000-2020).

3. The Process of Industrial Structure Adjustment

Under the guidance of the industrial restructuring policy, enterprises gave priority to the production of coal and steel, which was conducive to promoting the flow of production factors to heavy and chemical industries with higher efficiency and growth potential, thereby improving

the productivity and profits of the overall economy. After World War II, Japan, Germany, South Korea, Ireland all obtained external aid funds. With limited materials and capital, Japan focused on the production of coal and steel, and established a special agency (The Reconstruction Finance Bank) to provide more loans to enterprises that were crucial to the restoration of coal and steel production. The Japanese government also implements industrial rationalization policies, encouraging basic industries to improve production efficiency and reduce costs through equipment updates and technological improvements. For example, the “Outline of Rationalization Policies for the Steel and Coal Industries” formulated in 1950 was Japan’s first rationalization plan for the steel industry, which increased productivity by adding new equipment and renovating existing equipment and factories. (Okazaki, 2017). And encourage cooperation and coordination among special steel enterprises, strengthen the comprehensive capabilities of the group, thereby obtaining cheap and stable access to high-quality raw materials (Springer Singapore, 2020). The federal government provided financial support not only to coal and steel, but also to basic industries such as railways that facilitate transport coal and steel. To ensure the supply of coal resources, Germany’s support for the coal industry includes not only price subsidies, income tax incentives, and conventional measures such as rationalizing coal mine production and improving labor productivity, but also government acquisitions, retirement subsidies for miners, import restrictions, and research and development subsidies to ensure energy supply (Murat, 2015). Focusing on basic industry such as coal and steel, the economic efficiency was rapidly improved in a short period of time, which led to recovery of transportation and building materials, and provided a job market and increased workers’ income (World Bank, 1960). With the advancement of industrialization, the social structure has also undergone changes, the urbanization process has accelerated, the agricultural population has shifted to cities, and people have begun to pursue higher incomes. Germany and Japan have strengthened their economic strength and international competitiveness through the adjustment and optimization of their industrial structure, becoming important participants in the global economy.

In contrast, in the 1950s, Compared to the industrial and service sectors, agricultural production in South Korea and Ireland accounts for a higher proportion of the national economy, and development was relatively slow, with agricultural production accounted for 75% and 39% of the GDP in South Korea and Ireland respectively (Source: International Monetary Fund). The South Korean government has established the state-owned steel company POSCO and issued relevant laws to support the establishment

of the national champion company, providing various preferential conditions such as long-term loans with lower interest rates, infrastructure construction, reduction or cancellation of taxes and tariffs, and lowering utility rates. The direct impact of industrial restructuring policy was the recovery of coal and steel production, which triggered a shift in the industrial structure with a larger share of the secondary industry and a rapid economic recovery. These measures jointly promoted the industrialization of the economies of South Korea and Ireland, and the economic growth rate gradually increased.

Since the 1970s, the four countries have established scientific research institutions, laboratories and specialized research funds, and expanded the scale of university enrollment. (O’Malley, 1992; Geoffrey & Owen, 2012; McIlahon, 2011) Japan and Germany have implemented a shift from basic industries such as steel and coal to technology-intensive industries (Okazaki, 2017 ; Yano, 2020). and promoted cutting-edge products such as computers and semiconductors that require complex, modern scientific and technological production. Computer manufacturers (Fujitsu, Hitachi and Toshiba) received the subsidies for computer development, which covered 50% of their costs (Yano, 2020). The German government proposed to focus on advanced special ships in the shipbuilding industry and to enact laws to encourage the independent R&D technology (Hofmann & Orr, 2005). The manufacturing of semiconductors and advanced ships has higher added value than steel and coal, which refers to the economic value obtained when it is transformed into a final product or service through processing, assembly or service (Bamber, Brun, 2017). Therefore, it brings more profits to the enterprise. The application of technology-based manufacturing also achieved the industrialization of primary industries such as agriculture and husbandry. (Frederick, 2013) The use of tractors and seed drills increased production and efficiency, and raised per capita income levels. In 1995, the per capita income of Japan and Germany reached a 50-year high.

South Korea and Ireland followed the footsteps of Japan and Germany. In the 1980s, they rushed into high-tech industries, like electronics and semiconductors. South Korea formed major chaebols: Samsung, LG, SK, etc. In 1996, the per capita income exceeded US\$10,000. In 1961, the total number of people employed in Ireland’s manufacturing industry increased by 32.7% between 1981 and 1994 (Central Statistics Office of Ireland). Moreover, Ireland’s exports of computers and semiconductors have increased significantly. Therefore, the focus on developing technology-intensive industries is likely to be largely responsible for the increase in export trade. It increases society’s emphasis on knowledge and innovation and cre-

ates higher-quality jobs, while better-educated individuals are generally able to earn higher incomes, which helps improve the overall residents' living standards and spending power.

After the 21st century, the world economy transitioned from the industrial age to the information age. Countries actively expanded the proportion of the tertiary industry and increased the export of electronic products such as semiconductors. Japan's development lagged behind. In 1999, Japan's information technology funding was far lower than that of the United States, Britain, Canada, etc. (Noguchi, Japan's Reflection: Manufacturing Destroys Japan, 2014). Due to the slow upgrading of Japanese industries and strong competition from emerging Asian economies in traditional industries, the competitiveness of Japanese industries continues to decline. This has dealt a heavy blow to Japan, which relies on exports to drive economic growth. It entered a long-term economic recession, and the growth rate of per capita income declined significantly. Germany's per capita income growth rate also slowed down year by year. Germany over-relies on manufacturing industries such as shipbuilding and chemicals, and these technology-based industries face fierce competition from Japan and the United States (Chun, 2000). Over-protection of traditional industries has made Germany a victim of its own success. As a traditional industrial powerhouse, Germany's economic model has long relied on a strong manufacturing industry. With the increasing global demand for electric vehicles and autonomous driving technology, as well as strengthened environmental regulations, German car manufacturers need to increase their research and development investment and green transformation in these areas. Compared with countries such as the United States, Germany lags behind in investment and development in emerging technologies such as artificial

intelligence, digitization, and biotechnology. The German government has recognized this and proposed measures to strengthen research and industrialization in these areas in the National Industrial Strategy 2030.

However, the Irish government supported and exported the local software companies, computer services and biopharmaceutical companies, established Enterprise Ireland and Ireland Science Foundation, and introduced MIT Media Lab (Brennan, 2009). By 2007, Ireland's per capita GDP reached 43,321 euros (Central Statistics Office of Ireland, 2007). South Korea developed cultural industries such as music and games, The South Korean government has established the Ministry of Culture, Sports and Tourism, responsible for cultural development and exchange work, and providing tax incentives for entertainment and cultural enterprises, including exemption from comprehensive land tax, property tax, etc. In terms of industrial output value, it is second only to China, the United States, Japan and Germany (Source: Statistics Korea). The modern service industry can provide new impetus for economic growth. If its development is ignored, it may limit the growth potential and vitality. The development of the tertiary industry can effectively absorb labor, including high-quality workers. Emerging service formats continue to emerge, such as cultural and entertainment, health and elderly care, education and training, creating a large number of employment opportunities and alleviating employment pressure. Reasonable adjustment of the proportion of the tertiary industry will also improve people's happiness. With the increase in residents' income levels and consumption upgrades, the development of the service industry has met people's growing demands for culture, entertainment, and other aspects, improving their quality of life.

| The Proportion of Ireland's Three Industries in 2019 | | |
|---|-------------------------------------|---------------------------|
| | production value (million euros) | Share of total GDP (%) |
| primary industry | 37 | 1 |
| secondary industry | 1213.31 | 35.7 |
| tertiary industry | 1919.44 | 56.6 |
| Source: CSO (https://www.cso.ie/en/index.html) | | |

Fig 4 The proportion of Ireland's Three Industries in 2019

4. Unintended consequences

However, industrial restructuring also has unintended consequences, such as exacerbating regional development imbalances, and some countries may over-rely on external capital, affecting the independent innovation capabilities and long-term competitiveness of their own industries. In addition, it may lead to a slowdown in short-term economic growth because the decline of traditional industries may be faster than the growth of emerging industries. Alternatively, government support for the development of national champions may promote productivity improvement in the short term, but in the long run, it may lead to overcapacity, just like the 4 trillion yuan investment in infrastructure construction by the Chinese government after the 2008 global financial crisis (The Chinese Central Government's Official Web,2008). Although it avoided economic decline in the short term, it increased the capacity of many traditional industries in the long run, leading to serious overcapacity problems. The industrial restructuring may have an impact on the environment. For example, some highly polluting industries may be closed or relocated, but if alternative industries do not have corresponding environmental measures, it may cause new environmental problems in different regions.

5. Policy Recommendations

In summary, industrial restructuring policy can promote the evolution of production from low value-added to high value-added. From the analysis of the above four countries, the countries with the highest proportion of tertiary industry have obtained the highest per capita income. The government of developing countries should set up national champions. and encourage the development of high value-added industries through tax incentives, financial subsidies, industrial funds, etc. The government provides tax reduction or refund policies, especially for high-tech enterprises that invest heavily in research and development, to reduce their tax burden. Direct financial subsidies can also be provided to enterprises to support their technological innovation and market development. The government encourages financial institutions to bolster their credit support for enterprise technological transformation by utilizing financial instruments like interest subsidies and risk compensation, and sets lower loan interest rates. Secondly, the government should increase investment in research and development and innovation, encourage enterprises to transform technology and upgrade products. For example, actively develop modern service industries such as biotechnology and information technology to maintain the vitality of economic growth. Enterprises

can establish cooperative relationships with universities and research institutions to cultivate professional talents, including biological scientists, IT experts, data analysts, etc., encourage employees' innovative thinking, and support the technological innovation and service upgrading of enterprises. And promote digital transformation, such as Volkswagen replacing manual assembly tasks with robots, using artificial intelligence to evaluate and analyze data, and reducing energy consumption. Strengthen intellectual property protection to ensure that the innovative achievements of enterprises can receive legitimate rights and interests protection.

The government aims to build a new system of high-quality and efficient service industry, develop emerging service industries such as big data services, and ecological environmental protection services, and promote the integration of service industry with manufacturing and agriculture. For example, creating a human resources service industry park, developing manufacturing data services, carbon asset management and other emerging green and low-carbon services. Expand the effective supply of health, sports, culture and other service industries, such as improving the elderly care service market, simplifying the medical treatment process, and accelerating the establishment of a remote medical service system.

Don't become a victim of own success. With globalization and technology sharing, traditional industries often face competitive pressure from low-cost countries. Traditional industries such as steel and coal are resource and energy intensive, with a heavy environmental burden. In today's world where resources are limited and increasingly valued, excessive reliance on traditional industries is not conducive to sustainable development. Traditional industries may face challenges of automation and intelligence, leading to a decrease in employment opportunities. Emerging industries often require more highly skilled labor, which helps to improve overall employment quality and labor quality. If a country or region's economy overly relies on a few traditional industries, the stability and risk resistance of the entire economic system will be affected when these industries are subject to market fluctuations or external shocks. Therefore, industrial restructuring policies should encourage and guide the transfer of resources to emerging and high-tech industries, while also taking into account the transformation and upgrading of traditional industries.

6. Conclusion

In order to cope with these possible consequences, the government and enterprises need to take comprehensive considerations when carrying out industrial restructuring, including formulating reasonable industrial policies,

strengthening education and training, optimizing resource allocation, and enhancing environmental protection measures, to ensure that industrial restructuring can bring long-term and sustainable economic development.

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