

The Impact of Industrial Policy on Industrial Structure from the Perspective of New Infrastructure Based on Experimental Analysis

Hengda Gu

Wuhan University of science and technology, Wuhan, China

1169050504@qq.com

Abstract. This article theoretically describes the mechanism of the role of new infrastructure-related industrial policies on industrial structure optimization and upgrading and establishes a production function model for empirical analysis. This article innovatively collects the industrial policies introduced by Chinese provinces and cities from 1997-2021 and constructs a stock dataset of industrial policies related to new infrastructure construction. Combining the panel data on the scale of marketization, residential consumption, government expenditure, and human capital in each province and city, the generalized moment estimation method is used to test the role of national infrastructure construction-related industrial policies in promoting the rationalization and heightening of industrial structure, as well as the synergistic and complementary effects of national infrastructure construction-related industrial policies and the scale of marketization. The study finds that introducing and implementing new infrastructure-related industrial policies significantly contribute to the rationalization and heightening of industrial structure. The promotion effect of new infrastructure-related industrial policies on the optimization and upgrading of industrial structure is highly dependent on the degree of local marketization. Based on the above findings, the Chinese government should formulate and implement the new infrastructure-related industrial policies rationally based on the market mechanism and with the help of government capacity and policy tools to achieve industrial structure upgrading and market economy development.

Keywords: component; Industrial policy; Industrial structure; New infrastructure; Marketization.

1. Introduction

During China's rapid economic growth since reform and opening up, the development of various industries has been influenced by numerous government policies and actions, and the Chinese government has committed to using industrial policies to promote local economic growth. However, at the theoretical and empirical levels, industrial policies do not necessarily positively affect industrial development, and the successful development of industries does not necessarily stem from active government intervention and regulation. At the same time, affected by the COVID-19, China's economy faces new contradictions and challenges brought by changes in the external environment. It needs to speed up the construction of a new development pattern with a large domestic cycle as the mainstay and dual domestic and international cycles promoting each other. Under this background, deploying new infrastructure is an important part of fighting the recession caused by the COVID-19 and accelerating economic growth. The promotion of new infrastructure construction can stimulate the potential of domestic demand, drive the expansion of social employment and improve people's livelihood, and facilitate the optimization and upgrading of industrial structures.

Thus, it is clear that the new infrastructure-related industrial policies enacted by the Chinese government will have a profound impact on the Chinese economy. An in-depth discussion of this issue is of great significance to the study of China's economic development. Therefore, this article focuses on the impact of industrial policies on industrial structure from the perspective of new infrastructure construction, collects and organizes local regulations and local government regulations related to the new infrastructure construction industry, and constructs a dataset of local industry regulations related to new infrastructure construction at the provincial level in China as a proxy for the intensity of local government industrial policies on new infrastructure construction.

On this basis, the panel data of each province and region in China are combined to empirically test the promotion effect of industrial policies on the optimization and upgrading of industrial structure from the perspective of new infrastructure construction.

2. Materials and Methods

2.1 Literature Review

At present, the literature closely related to the topic of this article mainly covers the following three aspects.

Firstly, the research on industrial policy. In the process of economic development, the government, in order to achieve specific economic and social goals, intervenes in industrial development through a series of institutions by various means, which forms industrial policy. Therefore, whether industrial policy can effectively promote economic development has become a key issue of concern in economics. There are two different theoretical perspectives on whether government industrial policy is effective, and the reason for the difference lies in the different understanding of the roles of the market and government.

Marketists believe that a complete market mechanism can spontaneously form the optimal allocation of resources, while government intervention will cause market distortion. Zhang Shuguang believes that industrial policy can bring three negative effects: first, the government is overly aggressive and confident, introducing inappropriate industrial policies. Second, the government organization's administrative capacity is weak, unable to manage effectively, control, and apply resources and tools. Third, those in power in the government use industrial policies to achieve "catching up" in the name of rent-seeking, corruption, and accumulation of personal wealth or family group capital [1]. Yu Mingguai et al. found that at the level of corporate innovation, the market competition promotes technological innovation, but the role of industrial policies such as government subsidies, credit, and taxation mechanisms is not significant [2].

Governmentalists believe that there are defects such as monopoly or negative externalities in the market mechanism and that rapid economic development should be achieved through government intervention to obtain economies of scale and other latecomer advantages. Ricardo Hausmann and Dani Rodrik's study showed that markets are not omnipotent and that industrial development faces various externalities, incomplete and asymmetric information, and often over or under investment, resulting in problems such as overcapacity or excessive volatility [3]. Stiglitz Joseph E. argued that all types of markets are not complete and that incomplete financial markets for industries, products, and services, can lead to the inability of firms to fully rely on the market for resource allocation [4]. Dani Rodrik considered that enterprises could not autonomously complete the matching and coordination of technology application, resource allocation, and product production, thus failing to achieve the most efficient allocation of resources [5]. The study by Michael Peters et al. proposed that industrial policy helps guide the direction of industrial technology innovation and improve the efficiency of industrial innovation [6]. Similarly, many domestic scholars believe that the industrial policies pursued by the Chinese government have positive effects. Qian Chunhui and Zheng Ruogu argued that industrial policy could lead to the growth of total industry productivity [7]. Ling-Yun Song and Xian-Bin Wang argue that the government's industrial policy can increase the productivity increase of the supported industries [8].

Secondly, the study on industrial structure. Initially, industrial structure referred to the share of agriculture, industry, and services in the economic structure of a country. Now, the definition of industrial structure expands to the five-dimensional spatial relationship among the factors of production within industries, between industries, time, space, and levels. For China's industrial structure, many scholars have profound studies. Liu Wei and Zhang Hui have shown that industrial structure has a positive impact on economic growth, while this "structural dividend" gradually diminishes with the progress of reform [9]. In contrast, Li Xiaoping and Lu Xianxiang found that the "dividend" from industrial structure change was insignificant in their study of China's

manufacturing industry [10]. In recent years, more studies by Chinese scholars have confirmed that industrial restructuring is crucial for sustainable economic development. Yuan, Yijun, and Xie, Ronghui argue that industrial restructuring is the key path to address sustainable economic development [11].

Thirdly, research on the new infrastructure. As the definition of new infrastructure was first proposed at the Central Economic Work Conference in 2018, different perceptions of the areas included in the new infrastructure were different. The areas clearly identified by the central government include 5G networks, cloud platforms, data centers, artificial intelligence, industrial Internet, and Internet of Things. The National Development and Reform Commission has divided the new infrastructure into three areas, namely information infrastructure, convergence infrastructure, and innovation infrastructure. The National Information Center divides the new infrastructure into five levels according to the functional and technical characteristics of each level: perception layer, connection layer, platform layer, convergence layer, and application layer. According to Shang Wenshi, the new infrastructure can be divided into narrow-caliber information infrastructure and broad-caliber infrastructure that fill the shortage needs [12]. Based on the above ideas, the industrial policy documents related to new infrastructure construction collected in this article include local policies, regulations, and documents of the big data center, artificial intelligence, industrial Internet, Internet of Things, extra-high voltage, new energy, electronic communication, computer software, electric power supply, intercity rail transportation and other industries, and also policy documents related to the above industries.

Based on the existing literature, this article finds more current studies focusing on China's industrial policy and industrial structure, but less literature focuses on the impact between the two. Meanwhile, the concept of new infrastructure in China was introduced late, and there are even fewer related studies from the perspective of new infrastructure. Therefore, this article studies the impact of industrial policy on the industrial structure by quantifying the Chinese government's issued industrial policies and using inter-provincial panel data from the perspective of new infrastructure.

The industrial policy mainly influences industrial restructuring through two theoretical mechanisms. The first is the structure rationalization mechanism of industrial policy. The information and signals provided by the introduction of industrial policies, which are generally based on the collection and collation of a large amount of information and repeated research and judgment by government departments, are conducive to compensating for the externalities of the market, incomplete information, and asymmetry and other defects, and promoting the rationalization of industrial structure in the case of imperfect market mechanism and the difficulty of fundamental improvement in the short term. The second is the mechanism of the structural heightening effect of industrial policy. Under the regulation mechanism of industrial policy, government departments can, to a greater extent, bear the risk of market uncertainty in the process of technology research and development and application, etc. through operational means such as infrastructure construction, major scientific and innovative research programs, financial subsidies and credit support, guide all parties to concentrate on new technology research and development, bring into play the economy of scale effect and agglomeration effect of technology research and development, and promote the heightening of regional industrial structure. Therefore, industrial policy can theoretically promote the rationalization and heightening of industrial structure. Under the guidance of this theory, local government officials have great motivation to introduce and implement industrial policies, especially new infrastructure-related industrial policies, to pursue economic growth. According to the above two points, the following hypothesis is proposed:

Hypothesis 1: Chinese local governments focus on introducing new infrastructure-related industrial policies, and the new infrastructure industrial policies can promote the restructuring of local industries.

The government pursues the positive impact of industrial upgrading by introducing industrial policies, but behind this positive impact must meet certain prerequisites, such as the degree of

marketization of the economy. The industrial policy can work because of the imperfection of the market, which provides space and possibility for the government to play the initiative and improve economic efficiency. Generally speaking, the more apparent the lack of market mechanism, the more reasonable and justified the government force intervention. To a certain extent, reasonable government policies can make up for the lack of market and improve the efficiency of market operation. Therefore, the higher the degree of economic marketization, the greater the influence of industrial policy on industrial restructuring. Based on the above view, the following hypotheses are proposed:

Hypothesis 2: The degree of influence of new infrastructure-related industrial policies on industrial restructuring is influenced by the degree of economic marketization. The higher the degree of economic marketization, the greater the influence of new infrastructure-related industrial policies on industrial restructuring.

According to the above theoretical mechanism analysis, in order to test the influence of new infrastructure-related industrial policies on industrial structure optimization and upgrading, the following empirical model is constructed:

$$Y_{it} = \alpha P_t + \beta_1 M_t + \beta_2 C_t + \beta_3 G_t + \beta_4 \ln L_t + u \quad (1)$$

Among them, Y represents the index reflecting the optimization and upgrading of industrial structure, which is the interpreted quantity of this paper, including the industrial structure upgrading index and rationalization index. I represents region and t represents different years. P represents the stock of industrial policies related to new infrastructure, which is the core explanatory variable of this paper. M represents the degree of marketization, C represents residents' consumption, G represents government expenditure, and L represents human capital. α and β_1 , β_2 , β_3 , β_4 represent the elasticity coefficients of the stock of industrial policies related to new infrastructure, the degree of marketization, household consumption, government expenditure and the logarithm of human capital respectively, and u is a random disturbance term.

2.2 Variable Description and Data Description

2.2.1 Explained variable

Industrial structure optimization and upgrading index

Industrial structure optimization is defined as two aspects of industrial structure rationalization and industrial structure heightening. This article selects the index of industrial structure rationalization and the index of industrial structure heightening as the indexes to measure the optimization and upgrading of industrial structure.

The evaluation of industrial structure rationalization is dominated by the resource allocation theory, which believes that attention should be paid to the allocation, coordination, and utilization efficiency of factor resources among industries. This article measures the rationalization of the industrial structure by the coupling degree of factor input structure and output structure that is

$$R = \sum_{i=1}^n \left| \frac{(Y_i/L_i)}{(Y/L)} - 1 \right| \quad (2)$$

Y represents industrial output, L represents labor input, i is the i -th industrial sector, and n is the total number of industries.

The theoretical connotation of industrial structure heightening is highlighted as the change of industrial proportional relationship and the improvement of labor productivity. According to Clark's law, this article takes the proportion of output value of secondary and tertiary industries as the measure of industrial heightening, i.e., $U = \text{secondary industry} / \text{tertiary industry}$.

2.2.2 Core explanatory variable

This article adopts the statistical caliber of industrial policy in a narrow sense, including industrial structure, industrial organization, industrial technology, and industrial layout for regulation and guidance of policy measures, mostly in the form of "planning," "catalog," "outline," "decision," "notice," "reply letter" and other forms. Since China's industrial policies rarely appear in

the form of laws, but mostly in the form of administrative regulations and normative documents, local regulations, departmental regulations, and local government regulations. Therefore, measuring industrial policy from the perspective of the number of laws and regulations is a feasible approach to quantify "industrial policy" as a policy behavior variable. The collected industrial policy documents include big data centers, artificial intelligence, industrial Internet, Internet of Things, special high voltage, new energy, electronic communication, computer software, electric power supply, intercity rail transportation, and other industrial policy documents. Since China was officially connected to the international Internet in 1994, China Telecom started to provide dial-up Internet access to individual users in 1997. Therefore, using 1997 as the base year, we started to count the industrial policies of related industries. The industrial policy data in this article are all obtained from the national laws and regulations database. According to the data of China's current normative legal documents database, as of June 8, 2021, China has promulgated 24,938 legal documents of various validity levels, such as laws, regulations, and judicial analysis. Through the collation of this database and manual screening, this article initially obtained a total of 3862 policies and regulations related to new infrastructure construction-related industries. Through further screening and processing of the industrial policy samples of each province and city, this article obtains the cumulative number of local laws and regulations and government regulations of industrial policies in each province and city each year.

2.2.3 Control variable

Degree of marketization (M): The share of investment in fixed assets by non-state enterprises in each province in the total regional investment in fixed assets is used to measure.

Resident consumption (C): measured by using the data of resident consumption level in each province. $c = \text{resident consumption} / \text{per capita GDP}$.

Government expenditure (G): measured by using local government spending data of each province. $g = \text{Government spending} / \text{GDP}$.

Human capital (L): The product of the number of people in each province and the number of years of schooling per capita is used.

3. Results & Discussion

In order to solve the possible endogeneity problem in the model and ensure the robustness of the model regression results, this paper regresses the model using the generalized moment estimation method. Table I displays the regression results of the national new infrastructure-related industry policies on the industrial structure. Table II demonstrates the moderating effect of the market-based scale on the effect of industrial policy.

The P-values of AR (1) in both Table I and Table II are less than 0.05, indicating the existence of first-order autocorrelation in the model, and the p-values of AR (2) are greater than 0.05, indicating the absence of second-order autocorrelation. Therefore, the model passed the correlation test. At the same time, the Sargan test P-values are all greater than 0.1, indicating that the instrumental variables selected for the model are valid, and hence the model is estimated using generalized moment estimation.

Table I shows that the core explanatory variable new infrastructure related industrial policy stock has a significant positive effect on the rationalization and upgrading of industrial structure, and the regression coefficients reach 0.0932 and 0.0286 respectively. From the above results, it can be seen that the formulation and implementation of industrial policies related to new infrastructure have significantly promoted the rationalization and upgrading of industrial structure, and verified hypothesis 1, that is, Chinese local governments are committed to issuing industrial policies related to new infrastructure, and the new infrastructure industrial policies can promote the adjustment of local industrial structure.

In terms of control variables, the regression coefficient of the degree of marketization is significantly positive, and the impact on the heightened industrial structure is much greater than that

of rationalization, reflecting that the power of the market itself can promote the optimization and upgrading of the industrial structure. There is heterogeneity in the regression coefficient of resident consumption, which is unfavorable to the rationalization of industrial structure and favorable to the heightening of industrial structure, reflecting that the goods supplied by the current Chinese market are not suitable for residents' consumption preferences, and the low-end goods provided by the market cannot meet consumers' demand for high-end goods. Therefore, residential consumption has a negative impact on the rationalization of industrial structure but promotes the heightening of industrial structure. The regression coefficient of government spending is significantly positive, reflecting that the government actively promotes optimizing and upgrading regional industrial structures through investment and procurement. The log human capital regression coefficient is significantly positive, reflecting the positive effect of a high-quality labor force on industrial structure optimization and upgrading.

Table 1. Regression results of industrial policies related to new infrastructure on industrial structure

variable	rational structure of production	High industrial structure
Industrial policy stock (P)	0.0932*** (0.0142)	0.0286*** (0.0065)
Degree of marketization (m)	0.3649*** (0.0185)	1.2605** (0.1563)
Household consumption (c)	-0.0178*** (0.0035)	0.0081*** (0.0058)
Government expenditure (g)	0.0086*** (0.0029)	0.0097*** (0.0083)
Logarithm of human capital (L)	1.1170*** (0.0391)	0.6620*** (0.0554)
cons	-2.1684*** (0.4845)	-1.7796*** (0.4614)
AR (1) P value	-3.20 [0.001]	-1.79 [0.007]
AR (2) P value	1.70 [0.189]	1.53 [0.127]
Sargan test p value	24.29 [0.345]	30.01 [0.435]

In order to examine the synergistic effect of the degree of marketization and the industrial policy related to new infrastructure construction on the optimization and upgrading of industrial structure, based on model (1), the cross product term (PM) of the stock of the degree of marketization and the industrial policy related to new infrastructure construction is added as an explanatory variable and extended to model (2):

$$Y_{it} = \alpha P_t + \beta_1 M_t + \beta_2 PM_t + \beta_3 C_t + \beta_4 G_t + \beta_5 \ln L_t + u \quad (2)$$

The regression results of adding the cross-product term of the degree of marketization and the stock of industrial policies related to new infrastructure construction are shown in Table II. To examine the importance of the degree of marketization, this article calculates the degree of marketization and the influence of industrial policies on the rationalization or heightening of the industrial structure in year t based on $\alpha P_t + \beta_1 M_t + \beta_2 PM_t$. Taking the last year of the sample, 2020, for example, the mean values of B for 31 provinces and regions in that year are substituted into the above equation, and the corresponding values of industrial structure rationalization or heightening for the provinces and regions with the lowest and highest marketization degree in that year are calculated and compared, respectively. According to the results in column 1 of Table II, the measured results are 0.3627 and 1.294, respectively, i.e., the index of industrial structure rationalization in the provinces with the highest degree of marketization is 3.57 times higher than that in the provinces with the lowest degree of marketization. According to the results in column 2, the measured results are 1.5037 and 2.5983, i.e., the high index of industrial structure in the

province with the highest degree of marketization is 1.73 times higher than that in the province with the lowest degree of marketization. These differences show that the differences in the degree of marketization of each province and region lead to the differences in the degree of rationalization and heightening of industrial structure, whose economic effects cannot be ignored. The above analysis verifies hypothesis 2 of this article: that the degree of influence of the new infrastructure-related industrial policies on industrial restructuring is influenced by the degree of economic marketization, and the higher the degree of economic marketization, the greater the degree of influence of the new infrastructure-related industrial policies on industrial restructuring.

Table 2. The regulatory effect of market scale on industrial policy effect

variable	rational structure of production	High industrial structure
Industrial policy stock (P)	0.1576*** (0.1142)	0.0836*** (0.0646)
Degree of marketization (m)	0.8586*** (0.1815)	1.0778*** (0.2223)
Multiplicative term (PM)	0.2158*** (0.0576)	0.1972*** (0.0481)
AR (1) P value	-1.28 [0.025]	-1.77 [0.012]
AR (2) P value	0.95 [0.341]	0.81 [0.493]
Sargan test p value	14.29 [0.563]	20.04 [0.435]

4. Conclusions

This article firstly uses the industrial policies related to new infrastructure construction to be quantified. It empirically tests the driving mechanism of industrial policies related to new infrastructure construction in the rationalization and heightening of industrial structure, and the study finds that:

The new infrastructure is a new opportunity for China's high-quality economic development in the coming period, and the industrial policies related to the new infrastructure significantly promote the rationalization and heightening of the industrial structure. The impact on the rationalization of the industrial structure is greater than the heightening.

The higher the degree of marketization, the greater the influence of the new infrastructure-related industrial policies on industrial restructuring. The market plays a decisive role in resource allocation, and only an industrial policy that respects and relies on the market mechanism can effectively promote the upgrading of the industrial structure.

Based on the above research results, the following policy recommendations are proposed.

Industrial policy can significantly promote the optimization and upgrading of regional industrial structure. This affirms the value of the existence of industrial policy, and the role of industrial policy should be grasped scientifically to continuously improve the industrial policy system to promote the upgrading and transformation of industrial structure. To cope with the impact of the epidemic on the economy, the government should actively lay out new infrastructure industrial policies to enhance core competitiveness, get rid of constraints in large-scale integrated circuits, high-end equipment, industrial information control systems, and basic design software, and achieve industrial development to higher value chains.

The increase in the level of marketization has significantly promoted the optimization and upgrading of industrial structures. This requires the implementation of the decisive role of the market in the allocation of resources, through the standardization of the market trading system of factors and products, to ensure fair competition in the market, to promote the development of the

non-state economy, and other measures to promote the process of marketization. It is necessary to play the fundamental role of the market in resource allocation, emphasizing the "effective market," and to play the regulatory role of government industrial policy.

References

- [1] Zhang Shuguang. (2013) market dominance and government guidance -- a review of Lin Yifu's new structural economics.J. Economics (quarterly), 12 (03): 1079-1084
- [2] Yu Minggui, fan Rui, Zhong Huijie. (2016) China's industrial policy and enterprise technological innovation.J. China's industrial economy, (12): 5-22
- [3] Ricardo Hausmann,Dani Rodrik. (2003) Economic development as self-discovery.J. Journal of Development Economics,72(2).
- [4] Stiglitz Joseph E..(1993)The Role of the State in Financial Markets.J. The World Bank Economic Review,7(suppl 1).
- [5] Dani Rodrik.(1996)Coordination failures and government policy: A model with applications to East Asia and Eastern Europe.J. Journal of International Economics,40(1).
- [6] Michael Peters,Malte Schneider,Tobias Griesshaber,Volker H. Hoffmann.(2012)The impact of technology-push and demand-pull policies on technical change – Does the locus of policies matter?.J. Research Policy,41(8).
- [7] Gan Chunhui, Zheng Ruogu. (2009) research on industrial structure evolution and productivity growth since reform and opening up -- a test of China's "structural dividend hypothesis" from 1978 to 2007.J. China's industrial economy, (02): 55-65
- [8] Song Lingyun, Wang Xianbin. (2013) key industrial policies, resource replacement and industrial productivity.J. management world, (12): 63-77
- [9] Liu Wei, Zhang Hui, Huang Zehua. (2008) investigation on the height of China's industrial structure, industrialization process and regional differences.J. economic trends, (11): 4-8
- [10] Li Xiaoping, Lu Xianxiang, Zhu Zhongdi. (2008) international trade, technological progress and productivity growth of China's industrial industry.J. Economics (quarterly), (02): 549-564
- [11] Yuan Yijun, Xie Ronghui. (2014) study on the effect of industrial structure adjustment of environmental regulation -- An Empirical Test Based on China's inter provincial panel data.J. China's industrial economy, (08): 57-69
- [12] Shang Wensi. (2020) research on the impact of new infrastructure on labor productivity -- from the perspective of producer services.J. Nankai economicresearch,(06):181-20