

An empirical study on supply-side structural reform for industrial structure upgrading based on panel data in western China

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Abstract. In the context of economic downturn, structural contradictions are becoming more and more prominent, and to solve this problem, General Secretary Xi Jinping first proposed "supply-side structural reform" on November 10, 2015. Based on the panel data of western provinces from 2015 to 2020, the paper uses the industrial structure rationalization index (SR) as an index to measure industrial structure upgrading, and explores the influence mechanism of supply-side structural reform on industrial structure upgrading through fixed-effect, random-effect, and mixed-effect models. The robustness test further verifies that the supply-side structural reform has a robust and positive impact on industrial structure upgrading.

Keywords: Supply-side structural reform, industrial structure upgrading, western region, panel data.

1. Introduction

1.1 Research Background

In the important strategic period of the new economic normal, the new normal means that China's economy has entered a new stage different from the past nearly 40 years of high-speed growth, and the main contradiction of China's economic development is no longer the aggregate contradiction, but the structural contradiction. Affected by the domestic economic growth rate downward and demand slowdown, the solution of structural contradictions and the transformation and upgrading of economic and industrial structure must be realized through supply-side reform. Supply-side structural reform aims to moderately expand aggregate demand while strengthening quality supply from the production field, reducing ineffective supply, expanding effective supply, improving the adaptability and flexibility of supply structure, improving total factor productivity, and making the supply system better adapt to changes in demand structure.

Supply-side structural reform has been proposed for many years, and adhering to the main line of supply-side structural reform to promote the economy to continue to move forward on the road of high-quality development is a lasting and persistent economic policy. Deepening the supply-side structural reform is an important choice to adapt to the general logic of China's economic development into the new normal and promote the gradual alleviation of the total contradiction with the main line of solving the structural contradiction, which has a key role in industrial structure as well as economic transformation and upgrading.

This paper is based on this background, to study the real situation of the supply-side structural reform, draw conclusions and summarize corresponding suggestions to help promote economic transformation and better promote the development of western and even national economy.

1.2 Research Overview

On November 10, 2015, General Secretary Xi Jinping first proposed "supply-side structural reform" at the eleventh meeting of the Central Leading Group of Finance and Economics, and in the report of the 19th National Congress, it was also clearly pointed out that the supply-side structural reform should be deepened. Regarding the supply-side structural reform, we mainly review the literature from three aspects: theoretical basis, reform measures, and the effects and impacts. From

the theoretical basis of supply-side structural reform, Lin (2016) argues that our supply-side structural reform is not a policy of the Western supply school [1]. Unlike the tax reduction and the opposition to industrial policy, our current problem of insufficient aggregate demand and unreasonable supply structure requires us to carry out supply-side structural reform on the premise of moderate increase in aggregate demand, in addition to emphasizing that "industrial policy should be accurate" and that different industrial policies should be adopted according to the situation. According to Yin Yanlin (2016), supply-side reform is not the same as the advocacy of the supply school, but the reform of institutional mechanisms, not equal to structural adjustment, but the supply-side structural reform in China, not to engage in a new planned economy [2]. According to Zhang Yunqi and Feng Yi (2016), what is "supply side" is an economic term that corresponds to the demand side[3].

Supply-side structural reform is the government's policy change to reduce market distortion of resource allocation, strengthen market flexibility, reduce institutional transaction costs, and improve social productivity. Industrial structure upgrading, that is, through innovation and technological progress, adjustment and optimization and upgrading, so that the low-productivity morphological structure evolves to a high-productivity morphological structure and realizes the high-technology and high-value-added industries. Through supply-side structural reform, policies are continuously introduced to reduce the production cost and financing cost of enterprises, provide human capital for society and enterprises, improve the innovation environment of enterprises, and promote the upgrading of industrial structure.

In this paper, we choose the index of industrial structure rationalization to measure the impact of supply-side structural reform on industrial structure upgrading. GDP per capita, fiscal expenditure level, area of commercial proxy houses, agricultural productivity, industrial productivity and service productivity are selected as explanatory variables, and data from 10 provincial-level regions in western China from 2015 to 2020 are used for econometric analysis, so as to obtain the impact of supply-side structural reform on industrial structure upgrading in western China, and then propose optimization suggestions for industrial structure upgrading in western China[4].

2. Model Construction

2.1 Theoretical Analysis and Research Inference

The essence of industrial structure upgrading is the reconfiguration of the material means of production among economic sectors, which is reflected in the change of the proportion of output value of each industrial sector. At present, most of the indicators for measuring industrial structure upgrading in academic circles are dominated by the evaluation of industrial structure rationalization, and it is believed that attention should be paid to the allocation, coordination and utilization efficiency of factor resources among industries (Han Yonghui et al., 2017) [5]. For example, the industrial structure deviation degree, which measures the rationalization of industrial structure by comparing the value added of each industry and its employment, i.e., output structure and factor input structure:

$$\text{Industry Structure Deviation} = \sum_i^n \left| \frac{Y_i/L_i}{Y_i/L_i} - 1 \right| \quad (1)$$

Where Y_i denotes the output value of industry sector i , L_i denotes the number of people employed in industry sector i , and n is the number of industry sectors. According to the definition, Y_i/L_i is the productivity, so when the economy is in equilibrium, $Y_i/L_i = Y_i/L_i$, thus the deviation of industrial structure is 0. The larger the deviation of industrial structure, the more the economy deviates from equilibrium, and the more irrational the industrial structure is (Gan, 2011)[6].

However, in the actual economic operation is often dominated by the non-equilibrium state, the index of industrial structure deviation ignores the importance of each industry in the economy, treats the impact of each industry on the economy and the attractiveness of talents as equally effective, and

produces bias in economic research prediction. For this reason, the industrial structure rationalization index (SR) is introduced[7].

The industrial structure rationalization index (SR), also known as the Gan Chunhui Thiel index, was proposed by Gan Chunhui and other scholars in 2011 based on the Thiel index, and its calculation formula is:

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

Where Y and L remain the same as above to denote the value of industries and the number of employment. The dry Chunghui-Taylor index retains the advantages of industrial structure deviation, and by removing the absolute value calculation, and by weighting the output value, it avoids ignoring the importance of each industry[8]. the closer the SR value is to 0, the closer the economy is to the equilibrium state, and the more reasonable the industrial structure is; the more SR deviates from 0, the more unreasonable the industrial structure is. To sum up, this paper decides to adopt the index of industrial structure rationalization (SR) as the evaluation index of industrial structure upgrading.

2.2 Model Setting

Based on the above theoretical model, this paper empirically investigates the impact of supply-side structural reform on promoting industrial structure upgrading by establishing an econometric model. The specific model is as follows.

$$SR_{it} = \beta_0 + \beta_1 perGDP_{it} + \beta_2 finance_{it} + \beta_3 areaforsale_{it} + \beta_4 Ragricultural_{it} + \beta_5 Rsecondary_{it} + \beta_6 Rservice + \varepsilon_{it} \quad (3)$$

The explanatory variable SR is the evaluation index of industrial structure upgrading, i and t denote time and region respectively, where the explanatory variable $perGDP$ denotes GDP per capita, which measures the impact of supply-side structural reform on the demand side, and the increase of per capita GDP directly affects the change of consumer demand and thus the impact on industrial structure; $finance$ denotes the level of fiscal expenditure, which measures the impact of government policies on "cost reduction" in supply-side structural reform. $finance$ indicates the level of fiscal expenditure, which measures the impact of the government's "cost reduction" policy in the supply-side structural reform; $areaforsale$ indicates the area of commercial houses for sale, which measures the impact of the "destocking" policy in the supply-side structural reform on economic transformation and upgrading. $Ragricultural$, $Rsecondary$ and $Rservice$ denote the productivity of primary, secondary and tertiary industries, respectively, to measure total factor productivity, which is the goal of supply-side structural reform and the top priority in promoting industrial structure upgrading.

2.3 Data sources and statistical descriptions

The data involved in this paper are mainly obtained from the statistical yearbooks of western provinces, the China Statistical Yearbook, and the CEIC database. In view of the differences between regions and the availability of sample data, the sample data of Tibet Tibetan Autonomous Region are excluded from this paper, and because Inner Mongolia Autonomous Region has a large longitude span and only some areas belong to the west, this paper also does not consider the inclusion of Inner Mongolia Mongolian Autonomous Region in the sample. Since the supply-side structural reform policy was only formally proposed in 2015, in order to accurately study the impact of supply-side structural reform on industrial structure upgrading, the sample data selected in this paper are the panel data of western regions between 2015 and 2020, and Table 1 shows the descriptive statistics of relevant variables. Due to the problem of dimensionality among the samples, the data were standardized to ensure the validity and accuracy of the study, and due to the complexity of the calculation process, they are not listed for simplicity.

Table 1 Descriptive statistics of variables of interest

Variable Name	Sample size	Maximum value	Minimum value	Average value	Standard deviation
SR	60	-0.01	-1.087	-0.683	0.274
PerGDP	60	78294	25946	45795.117	11694.509
areaforsale	60	4.147	2.726	3.661	0.316
Ragricultural	60	1.974	0.802	1.263	0.271
finance	60	0.643	0.196	0.347	0.122
Rsecondary	60	5.836	2.31	2.831	0.512
Rservice	60	4.947	2.016	2.395	0.381

3. Model solving and analysis

3.1 Baseline regression results

In this paper, fixed-effect, random-effect, and mixed-effect regressions were conducted on the models based on panel data to analyze the impact of supply-side structural reform on industrial structure upgrading, and the specific regression results are shown in Table 2. Model I, fixed-effects model, the regression results portray the different impacts of supply-side structural reform on industrial structure among western provinces. Due to regional differences, the depth and speed of the impact of supply-side structural reform on industrial structure in different regions are different. From the regression results, the coefficients of government expenditure level (finance) and area of commercial properties for sale (are for sale) are not significant, probably because the economic development level of western region is lower than other regions for a long time, and there are differences in economic development level and industrial structure among western provinces, so the supply-side structural reform such as "The implementation of supply-side structural reforms such as the "three to go, one down, one up policy" needs to be done in a localized and targeted manner.

Table 2 Baseline regression result

Explained variable: SR Explanatory variables	Fixed effects model	Random effects model	Mixed effects model
const	-0.392***	-0.146**	-0.146**
finance	-0.078	1.601***	1.601***
Ragricultural	3.139***	0.288***	0.288***
areaforsale	-0.216	0.292**	0.292**
perGDP	0.0001***	0.000***	0.000***
Rsecondary	-0.381**	-0.711***	-0.711***
Rservice	0.329**	0.616***	0.616***
R ²	0.785	0.759	0.759

Note: ***, **, * represent 1%, 5%, 10% significance levels, respectively

The regression results of model 2 and model 3, random effect and mixed effect models portray the impact of supply-side structural reform on the overall industrial structure in the western region, and from the regression results, we can see that the coefficients of all explanatory variables are significant at the 0.05 confidence level, among which the coefficients of fiscal expenditure level (finance), agricultural productivity (Ragricultural), tertiary industry productivity (However, the coefficient of secondary industry productivity (Rsecondary) is negative, indicating that the increase of secondary industry productivity will have a negative impact on the upgrade of industrial structure, probably because of the allocation effect of productivity on labor force, and the increase of secondary industry

productivity makes its role in absorbing labor force further weakened, forcing the labor force to shift to choose the tertiary industry with relatively lower productivity, which relatively reduces the allocation efficiency and causes the sectoral productivity gap and income gap to widen, thus bringing a negative impact on industrial structure upgrading (Duan Jun and Yang Jun, 2011) [9]; then look at the coefficient of GDP per capita (perGDP) Although it has a positive impact on industrial structure upgrading, the coefficient tends to be close to 0 and The impact on industrial structure is small, probably because the impact of per capita GDP on industrial structure is more indirect and the direct transmission is smaller.

3.2 Robustness tests

The regression results of the robustness test are shown in Table 3. Since the advanced industrial structure focuses on the exploration of the secondary and tertiary industries, the regression coefficient of agricultural productivity (Ragricultural) is not significant, and the other regression results of GDP per capita (perGDP), secondary industry productivity (Rsecondary), tertiary industry productivity (Rservice), and fiscal expenditure level (The significance, positive and negative coefficients of the regression results of GDP per capita (perGDP), productivity of secondary industry (Rsecondary), productivity of tertiary industry (Rservice), and fiscal expenditure level (finance) are consistent with the results of the benchmark regression, and R^2 is basically consistent with the results of the benchmark regression, and the model has strong explanatory power. It shows that the supply-side structural reform has a robust and positive effect on industrial structure upgrading in both dimensions of industrial structure rationalization and industrial structure advancement. The supply-side structural reform plays a crucial role in the upgrading of industrial structure.

Table 3 Robustness tests

Explained variable: Advanced	Fixed effects model	Random effects model	Mixed effects model
Explanatory variables			
const	-0.122	0.017	-0.589
finance	1.041**	0.965**	0.888**
Ragricultural	0.048	0.212	0.112
areaforsale	0.084	0.042	0.17
perGDP	0.0001***	0.000***	0.000***
Rsecondary	-0.395**	-0.397***	-0.352***
Rservice	0.389**	0.399***	0.403***
R^2	0.722	0.716	0.799

4. Conclusions

A regression model is constructed through panel data from 2015-2020 to empirically analyze the impact of supply-side structural reform on industrial structure upgrading in the western region. The regression results of the fixed-effects model are used to derive the different effects of supply-side structural reform on the industrial structure among the western provinces. The regression results show that the regression coefficients of government expenditure level and area of commercial properties for sale are not significant, while agricultural productivity, GDP per capita and tertiary industry productivity bring positive effects on industrial structure upgrading with regression coefficients of 3.139, 0.0001 and 0.329, respectively. The regression results show that the level of fiscal expenditures is higher than the level of fiscal expenditures. The regression results show that the level of fiscal expenditure, agricultural productivity, and tertiary industry productivity bring positive effects on the upgrading of industrial structure, and secondary industry productivity brings negative effects on the upgrading of industrial structure. (Duanjun and Yang, 2011) argued that the increase of secondary

industry productivity further weakened its role in absorbing labor, forcing labor to shift to choose the tertiary industry with relatively lower productivity, which relatively reduced the allocation efficiency and caused the sectoral productivity gap and income gap to widen, thus bringing negative impact on industrial structure upgrading[10].

The indicators of advanced industrial structure in the western region show an overall upward trend, but due to regional differences in factor endowment, industrial foundation and economic development, the depth and speed of the impact of supply-side structural reform on industrial structure in different regions are different, among which Sichuan, Gansu and Chongqing have outstanding effects on industrial structure upgrading, while Shaanxi, Xinjiang and Yunnan still need to be improved.

In addition to the implementation of "three to one step", the western region should also carry out industrial structure upgrading when carrying out supply-side structural reform. The two are mutually reinforcing and complementary to the development of the western region. When formulating policies, the actual situation in the region should be taken into account, taking into account the differences in economic development between the western region and the east and central regions, and making policies that are conducive to the development of the region according to local conditions.

Combined with the analysis of the full text, the following suggestions are made:

- Combine the realities of regional industries and reasonably grasp the strength of reform
- Policy starting point should be shifted from short-term to long-term policies.
- Actively strengthen technological innovation and improve the quality of product supply
- Improve the mechanism of talent introduction and cultivation

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