Resource Reallocation, Industrial Structure Transfer and Economic Growth—Empirical Analysis Based on Shandong Province

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Abstract. Currently, both resource allocation and industrial structure optimization are significant issues which China's economic transformation and development are facing. Utilizing the Wurgler, the classic econometric model, to calculate the adaptability between resource reallocation and structural transfer emerged in Shandong province, the results show that the efficiency elasticity of capital allocation and the configuration coefficient of labor elements are both positive but relatively small accompanied with weak "structural dividend", revealing that there are still larger room to optimize the industrial structure. In order to achieve the transformation and upgrading of industry and realize the new driving forces to support economy by taking place the old ones, Shandong province needs to accelerate and adjust the factors marketization reform and industrial structure, then improve the overall quality of the industry and promote technological innovation.

1. Introduction

China has experienced more than 30 years of rapid economic growth since the execution of reform and opening-up policy, because of the existence of the multiple constraints, however, which involves the tapering dividend space such as the population, openness and resource, includes the diminishing marginal returns of capital and covers increasingly environment requirement, it is hard to maintain the high economic growth just relying on the way of extensive development through low cost and cheap inputs, so economic development is urgently faced with shifting gear, adjusting structure and converting driving power. Under the new normal of economy, it is the only way to achieve long-term sustainable economic growth to raise factors production efficiency, while the improvement of production efficiency is mainly realized through scientific and technological progress, endogenous economic growth and industrial structure change. Furthermore, there is a distinction in operation mechanism, both the technological progress and the endogenous economic growth drive the promotion of the economy overall productivity by the increase of department TFP, but industrial structure transfer influence total productivity growth through the flow of production elements from the sectors of lower productivity lever or of lower productivity growth to the higher ones. Therefore, under the background of the transformation from extensive economic growth dominated by factor input to intensive economic growth dominated by quality and efficiency, the study of economic growth inevitably involves factor allocation and industrial structure changes.

The process of modern economic growth is not only the course of productivity growth, but also the procedure of economic structural adjustment. Whether a country or a region can achieve long-term sustainable growth has a lot to do with the success of structural transformation. The theory of structuralism links the transfer of industrial structure with the long-term economic growth, and holds that the change of industrial structure achieves the improvement of production efficiency through the reallocation of factors, which not only has the growth effect, but also belongs to intensive growth, and it is definitely a vital spring of promoting the enhancement of economic growth quality. In the course of industrialization, the effect of industrial structure change on economic growth varies with the level of development. This kind of feature performs prominence especially in developing countries. This is due to the fact that change of industrial structure in developing countries, in general, occurred in disequilibrium state, particularly in the factor market. In other words, the factors of production have the diverse output efficiency among different sectors, making the elements of
capital, labor and so on flow and reset between different sectors, and swarm into the department of higher productivity levels or of higher productivity growth to accelerate economic growth and promote the improvement of economic growth quality. The effect of such factor reallocation on economic growth is called factor reset effect, and the positive factor reset effect is also named "structural dividend". Since the reform and opening up, Shandong province has actively promoted the transformation of development mode and optimized the transfer of industrial structure continuously, which has nudge the economic growth of Shandong province. In the new historical period, is there any new room to optimize and upgrade the industrial structure of Shandong province? Can the current efficiency of factor allocation be improved under the guidance of a major project about converting old kinetic energy into new one? Only by studying the above problems and making clear the current situation and existing issues of the industrial structure can we truly stand on the perspective of supply-side reform, improve the quality of supply, promote structural adjustment, relieve the distortion of factor allocation and enhance the effective level of supply.

2. Literature Review

The research results of the new growth theory and structuralist development theory show that the modern economic growth is not only reflected in the productivity growth, but also in the constant adjustment of economic structure, especially in the flow of production factors and the change of industrial structure. Referring to the relationship between the factors reset and economic growth, Lewis' dual structure theory suggested that there exists a dual economic structure in developing countries, and the factors of production represented by the countryside surplus labors presents the transfer from the agricultural sector of low productivity to industrial department of much higher productivity, then this course will not be ceased until the binary structure disappears\(^1\). Yet it is the main reason for the rapid growth of economic output that the economic elements flow between each department (Kuznets, 1955)\(^2\). After the 1980s, the structuralist school believed that continuous improvement and optimization of industrial structure could improve the efficiency of allocation to factor resources and thus promote economic growth under the disequilibrium conditions\(^3\). Moreover, Harberge describes the economic growth divided into two forms in his research: one is that factors move from the industry of low productivity to the sector of high one, which is reconfigured to improve the production efficiency and drive the economic growth; the second is to introduce new technologies and improve management to increase their production efficiency so as to achieve economic growth \(^4\). Therefore, promoting factor replacement and structural change, the core of economic growth, has become one of the research focuses.

In early studies, scholars such as Clark (1940), Kuznets (1957), Denison (1967) and so on systematically put forward the theory of the impact of industrial structure changes on economic growth. Clark (1940) comprehensively applied Fisher's research results on industrial division, as well as Petty's theory about the evolution trend of labor force moving between different industries, proposed the "Petty-Clark theorem", and pointed out the law of labor force moving from the first industry to the second and third industry ,this process promoting economic growth. However, the single labor force index is difficult to reveal the general trend and development rule of industrial structure change at a deeper level. The research of Kuznets (1979) shows that economic growth is accompanied by the continuous transformation of economic structure \(^5\). The main point of economic activities in a country shift from agricultural sector to non-agricultural sector and range from industry to service sector, and structural change has a positive contribution to economic growth. Further, Chenery (1986) and Syrquin (1986) used the concept of structural change and factor replacement effect to point out that this effect was a key factor to promote growth\(^6\). Chenery (1986) found that the factor replacement effect caused by changes in industrial structure mainly experienced a process of acceleration initially and then slowing down, and this course appeared in various stages of development. Syrquin (1986) emphasized the significant contribution of factor replacement to TFP and GDP growth, and considered that structural change was an important feature of economic development process and an essential factor to explain the speed and quality of economic growth. Peneder (2002) found that due to the existence of phenomenon that there are diverse productivity
levels and productivity growth in different sectors, when the factors of production gradually shift from the low productivity sector to the high one, it will significantly increase the productivity of the overall economy, and the theory to explain the productivity growth through factors' flow was summed up as "structure dividend" by Timmer & Szirmai, so as to promote the sustained economic growth[7]. The industrial structure transfer is formed by the basis of factor flow, and the positive contribution of such industrial structure change to productivity growth is the "structural dividend hypothesis".

Based on this hypothesis, domestic and foreign scholars began to study the relationship between structural changes, factor replacement and economic growth from both theoretical and empirical aspects, and the empirical results were different. Salter's research results showed that factor flow between British manufacturing industry had a significant promoting effect on productivity improvement between 1924 and 1950[8]. On the contrary, some studies have shown that the structural dividend hypothesis is not significant. Study of the United Nations industrial development organization (UNIDO) revealed that the internal growth effect reflects a process that certain sector raises levels of productivity through its own innovation activity, which often require mature national innovation system, the good foundation of human capital and all kinds of resources the R&D needed, therefore it is generally assumed that internal effect plays a dominant role in advanced economies. Developing countries, however, are in the process of structural transformation and do not have sufficient innovation resources, so external effects may explain productivity growth better. Two scholars, Saccone and Valli, dissect the labor productivity growth in China and India. They believe that the internal effect is much stronger than the resetting effect of industrial structure in China, indicating that China's economic growth has little to do with the transfer of factors between industries, which is mainly attributed to the excellent performance of each sector. In contrast, although the contribution of structural factors is only about half of the internal effect in India, structural adjustment does play an important role[9].

In the research of domestic scholars, some documents affirmed the positive effect of factor flow and industrial structure evolution on economic growth since the reform and opening-up. The research of Zhang Jun and Chen Shiyi found that the industrial structure reform led to the replacement of inter-industry factors, and indeed promoted the improvement of industrial productivity[10]. The change of industrial structure in China's economy is considered as an enormous embodiment of market-oriented reform. However, the contribution of industrial structure change to economic growth gradually gives way to technological progress in recent years. To further improve the efficiency of resource allocation depends on breaking some obstacles of development and institutional factors. Of course, there are still many issues in the current industrial structure adjustment. Some scholars have found that, in 1999-2009, the reallocation of labor and capital elements in China even contributed negatively to economic growth(Zhao Chunyu, 2011)[11]. Although the test result of the empirical study on the structural dividend hypothesis is inconsistent, we can't deny the bond of elements reset and productivity, especially for China of key transition stage. Because of the existence of deviation in industrial structure and the imperfection of market mechanism, optimization and upgrade of industrial structure, as well as element configuration, become the crucial problem facing national and regional transformation of economic development nowadays.

3. The Industrial Structure Changes of Shandong Province Since the Reform and Opening up

Similar to the development trend of the national economy, the economy of Shandong province has also shown a rapid growth trend since the reform and opening up, and the three industrial structure changes are also significant in this process. The industrial structure has experienced a process from unreasonableness to gradual reasonableness, from adjustment to continuous improvement and optimization. As can be seen from figure 1 and figure 2, in the early stage of reform and opening up, the added value of the primary industry was 7.506 billion in Shandong province in 1978, accounting for 33.3% of the total GDP, 2.41 times that of the tertiary industry. Since the reform and opening up,
with the rapid economic development, the total agricultural output value increased by about 34.5 times by 2015, but it was far behind the 51.98 times of growth rate in the second industry, especially 141.28 times of that in the third industry. The proportion of primary industry in GDP declined from 33.3% in 1978 to 16.7% in 2015, down by 16.6 percentage points. In addition, its contribution rate to economic growth also declined with fluctuation, and it basically remained below 10% after the 1990s. At the same time, the proportion of secondary industry (mainly involves industry) in GDP experienced a course of initial decline and then rise, but it has always been the dominant force of economic growth. And the contribution of that to economic growth in 1980-2015 reached an average of 60%, even reached up to 90% in some years. Besides, proportion of the tertiary industry in GDP rose from 13.8% to 34.5%, increased by 20.7%, and even employment population is increased by 26.3%. The contribution rate of tertiary industry to economic growth showed the upward trend of fluctuations, especially exhibited a rapid rise after the financial crisis in 2008, and almost matched with the second industry contribution. This shows that the tertiary industry contributes increasingly to GDP, and its role in the whole national economy is enhancing. Although the proportion of service industry in GDP in Shandong province is still relatively low compared with developed countries, the service industry in Shandong province has increased by 141.28 times in just 32 years. And the main reason why the ratio of service industry to GDP is not high is just that the industrial development goes faster. With the continuous deepening of reform, the development potential of Shandong’s service industry is gradually unveiling, and its proportion in regional GDP will likewise be growing.

![Figure 1. The Proportion of Three Industries in GDP of Shandong Province (1978-2015).](source)

Note: the red stands for primary industry; the yellow refers to secondary industry; and the blue represents tertiary industry. They are also suitable for the figure 2.

Source: Shandong statistical information network: Shandong statistical yearbook 2016

![Figure 2. Contribution Rate of Three Industries to Economic Growth in Shandong Province (1980-2015).](source)

Source: Shandong statistical information network: Shandong statistical yearbook 2016

4.1 Model Selection

There are two commonly used methods to measure the effect of factor reset and structural change, one is the deviation quota method proposed by Fabrican (1942) and the other is the way used by Chenery (1986) in the analysis of the multinational model. Although the deviation share method can effectively analyze the structural problems, it can only measure the structural change effect of a single element, which is well rough to analyze the transfer of industrial structure. However, multinational model method overcome the restrict of measuring the number of elements while deviation share method is inevitable, and it can simultaneously consider the contribution of both capital and labor structure change to economic growth. But because of the reason that the choice of control variables is much vague in the process of its regression, once ignoring important control variable, it will produce that analysis is not accurate, and how to measure the industrial structure of model is also a difficulty. This project uses the classic Wurgler (2000) model to study the relationship between factor reset and output value growth. It takes the sensitivity of factor flow to GDP change as the measurement standard of factor allocation efficiency, and it can consider the change of allocation effect of various factors at the same time, avoiding the deficiencies in the research of the first two methods to some extent. The empirical model is as follows:

\[
\ln \frac{I_{t,i}}{I_{t,i-1}} = \alpha_i + \eta_i \ln \frac{GDP_{t,i}}{GDP_{t,i-1}} + \epsilon_{t,i}
\]

In the model, \(i\) is the industry number; \(T\) is the year; \(I\) is the input of fixed capital flow (replacing \(I\) with \(L\) when calculating labor allocation efficiency, and \(L\) stands for employees); \(\frac{GDP_{t,i}}{GDP_{t,i-1}}\) is the change index of gross domestic product, that is, the change of gross domestic product relative to the previous year; \(\eta\) is the reflection coefficient of investment, indicating the flexibility level of the increase and decrease of capital (labor) in various industries to the change of GDP growth. When \(\eta\) is greater than zero, it shows that when the gross product of an industry increases relative to that of the previous year, the growth rate of capital (labor) flowing to an industry will increase accordingly. In other words, more capital (labor) will flow into industries with relatively faster GDP growth, and less capital (labor) will flow into industries where output growth is relatively slow. It is just the other situation that \(\eta\) is less than zero, in that when the GDP of a certain industry grows relatively, the growth rate of capital (labor) will decrease instead. When \(\eta\) is equal to zero, however, it means that capital (labor) inflows have nothing to do with the growth of the industry's GDP.

4.2 Source and Collation of Data

Due to the lack of annual data in different industries, we chose the panel data of the three major industries in the overall economy from 2005 to 2015, which are used to calculate the factor allocation efficiency. And the specific divisions of three industries are as follows: the first industry (agriculture, forestry, animal husbandry and fisheries), the second industry (manufacturing, mining, electricity, gas and water supply industry are collectively referred to as the "industrial" and construction), the third industry (transportation, warehousing, postal service, wholesale and retail, accommodation and catering industry, finance, real estate, and other services).

In the calculation of factor allocation efficiency, basic data are derived from wind database and statistical yearbook of Shandong province from 2000-2016. The input and output data involved are as follows:

- Labor input index. Take the number of employees (ten thousand) at the end of the year as the proxy variable of labor input.
- Capital investment indicator. The fixed capital stock (RMB 100 million) calculated by the perpetual inventory method is used as the proxy variable of capital input. In this paper, the fixed asset investment completion amount of all industries in Shandong province in 2003 is set as \(K_t\), and the asset depreciation rate is still set as 11.28%.
Output indicators. Nominal GDP (100 million yuan) is utilized as the proxy variable. All the data did not take into account the impact of price factors, and in order to eliminate the impact of dimensionality on the data, values of the above data were standardized by the method of the maximum and minimum.

4.3 Empirical Results and Analysis

Based on the above model, the panel data estimation method is applied to estimate the capital (labor) allocation efficiency of the total economy. Hausman test shows that fixed effect model should be selected for regression analysis, and the results are shown in table 1.


<table>
<thead>
<tr>
<th></th>
<th>Capital allocation efficiency</th>
<th>Labor allocation efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>η</td>
<td>0.310***</td>
<td>0.223*</td>
</tr>
<tr>
<td></td>
<td>(-0.107)</td>
<td>-1.93</td>
</tr>
<tr>
<td>Constant</td>
<td>0.179**</td>
<td>0.226***</td>
</tr>
<tr>
<td></td>
<td>(-0.0685)</td>
<td>-3.04</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.097</td>
<td>0.04</td>
</tr>
<tr>
<td>Observations</td>
<td>88</td>
<td>88</td>
</tr>
</tbody>
</table>

Note: t statistics are shown in brackets, *** p<0.01, ** p<0.05, * p<0.1

On the whole, the capital allocation efficiency of overall economy in Shandong province was 0.310 and labor allocation efficiency was 0.223 from 2005 to 2015. The factor reallocation of total economy is less elastic to the change of GDP, and the change of capital and labor reallocation is the same with the increase of GDP. That is to say, the change of capital and labor structure in the overall economy has a weak positive effect on promoting the increase of GDP, and in comparison, the contribution effect of capital structure change on economic growth is slightly greater than the impact of labor structure adjustment. The research results are basically consistent with the research conclusions of Yao Zhanqi (2009), and line with the study findings for China's overall economy by Gan Chunzhen and Zheng Ruogu (2009). They found that during the period of 2001-2007, capital structure changes had a faint "structural dividend" for capital productivity growth, and labor structure changes took on a "structural dividend" for labor productivity growth and tended to weaken. However, it is contrary to the conclusion that the elasticity coefficient of capital allocation efficiency is negative, which is come to by Zhao Chunyu (2011). This paper argues that, on the one hand, as Shandong province is a relatively independent economy in China, its industrial structure has its own particularity, which will make capital play a positive role in the process of its reallocation. On the other hand, because of selecting the capital stock in this paper as the proxy variable of capital investment instead of the fixed asset net value adopted by Zhao Chunyu (2011), which may lead to the difference of the results.

It can be seen from table 1 that the elasticity coefficient of capital allocation efficiency of the overall economy is positive but relatively small. On the one hand, it reflects that in recent years, Shandong province has achieved positive results in adjusting the structure and transforming the mode, and more and more capital flows to industries with high added value and high productivity. On the other hand, the existing industrial structure still has a large space for improvement. Due to the influence of the overall national policy, industrial structure of Shandong province has certain deviation for a long time. Although the structure of the three industries is increasingly reasonable, the capital input of the primary industry is insufficient and the tertiary industry lags behind in development. Especially, the market-oriented reform of producer services is slow, and it still exists...
the phenomenon of the lack of effective market competition mechanism, leading to a lower production efficiency and a situation that capital can't flow freely, which severely restricts the capital allocation efficiency. Similar to the efficiency of capital allocation, the structural changes of labor factors in overall economy also contribute positively to the economic growth. This is because in the process of industrialization, a large amount of surplus labor in the primary industry is transferred to other industries, resulting in negative growth of employment in the primary industry. In recent years, with the advancement of urbanization and industrialization in Shandong province, a large deal of rural labor force has been transferred to the construction industry, which has absorbed a great many agricultural surplus labors. At the same time, due to the development of the non-public economy such as the individual and private sector of the tertiary industry, as well as the improvement of technological progress and production efficiency, the labor force transferred from agriculture and industry flowed into the tertiary industry, and the tertiary industry became the most important sector to absorb the labor force. Therefore, the structural changes of the three major industrial labor factors in the total economy have a weak "structural dividend" for productivity growth.

5. Cause Analysis and Enlightenment of Weak "Structural Dividend" in Shandong Province

Since the reform and opening up, the industrial structure of Shandong province has been changing, adjusting and optimizing, but overall it is still a weak "structural dividend". In the new era, analyzing the cause of this weak dividend from the perspective of industrial structure change, promoting industrial optimization and facilitating the transfer of kinetic energy, which will be conducive to the promotion of the current major project, the transformation of kinetic energy from old to new, in Shandong province. By analyzing the reasons for the weak "structural dividend", we think it can be shown in the following three aspects:

First, the overall level of industrial structure in Shandong province is relatively low, and the structure is unbalanced. Outstanding performance is that the first industry is weak, the second industry is advanced, and the third industry is insufficient. First of all, the lack of strong foundation support for agricultural development, low modernization level and low efficiency of agricultural labor production have restricted the sustainability of agricultural development. Secondly, the proportion of the secondary industry is too high, and the industrial structure is not sufficiently advanced in practice. In addition, the manufacturing industry is large but not strong, and some industries, such as steel and processing, have serious overcapacity at a low level. Furthermore, the industrial economic growth of Shandong province mainly depends on the investment pull and quantity expansion. From the perspective of the change of industrial structure and department structure, the nominal advanced extent level of Shandong province is relatively high, while it is relatively low from the perspective of added value, technological content, international division of labour status and so on. Moreover, the processing degree of industrial products is low and the transition to deep processing is slow. The processed products are mostly primary products with low added value, and economic growth lacks effective support of scientific and technological progress. Thirdly, the service industry has a relatively low proportion and lags behind in development. It is dominated by traditional service industry, and its internal structure is not very reasonable. Besides, the contradiction of its own structure is prominent, and the ability of technological innovation and institutional innovation cannot meet the needs of social and economic development.

The second is the imbalance of employment structure in three industries. The proportion of primary industry employment is on the high side, while the proportion of tertiary industry employment is on the low side. The employment ratio of the three industries in Shandong province has been improving since the reform and opening up. In 1978, the employment ratio of the primary industry was as high as 79.2%, but it was 29.6% by 2015. The employment ratio of the secondary industry and the tertiary industry rose from 12.3% and 8.5% respectively in 1978 to 35.2% in 2015. However, compared with developed countries, the proportion of tertiary industry employment in Shandong province is significantly lower than the proportion of 60% in major developed countries and newly industrialized countries, while the proportion of primary industry employment is far higher than the proportion of less than 10% in these countries. It is evidently that employment
structure level of three industries is still low, and the employment structure of that directly affects the transfer of surplus agricultural labor to industry and service industry with higher productivity level and income level. A large amount of capital is invested in industries with low growth rate, and the relatively extensive economic growth mode aggravates the constraint of basic industries on economic growth. And a great deal of capital is also invested in basic industries and heavy chemical industries with high energy consumption, high pollution and low technological level, which leads to industrial bottleneck and repeated construction and thus wastes a large number of resources. On the one hand, the current system makes the heavy chemical industry be enlarged, which intensifies the disadvantages of that. On the other hand, the lack about awareness of environmental protection and of innovation in the process of heavy chemical industry, as well as the failure to follow the new industrialization road of high and new technology, has caused the cost of economic growth to be particularly high in Shandong province in recent years and that the quality of growth is not high.

Third, the industrial quality is low and uncoordinated, and the technical innovation ability is poor. The disharmony of industrial quality is mainly reflected by the obvious technical fault between industries and the sharp contrast of labor productivity. Although the development of high-tech pillar industries in Shandong province has been accelerated in recent years, the application of high and new technologies to the transformation of traditional industries is relatively poor in intensity and effect, yet it fails to give play to its leading role in promoting the overall economic development and structural upgrading. Moreover, many industries are at the low end of industrial division due to the lack of key technologies and equipment of independent intellectual property rights and the low technology of high-tech industries. As a result, Shandong province has severe overcapacity in low-quality, low-grade and low-value-added products, while high-quality, high-grade and high-value-added products are not produced enough and can only rely on imports. These problems will affect and restrict the improvement of industrial quality and the upgrading of industrial structure in Shandong province for a long time.

On the whole, the reform of factor marketization in Shandong province lags behind relatively, and the price of resource and factor is distorted, which objectively results in the mismatch and waste of resource and factor of production. The main cause of these problems is that the prices of resources and elements do not adequately reflect their scarcity. Reasonable price signals can not only guide the rational allocation of elements and encourage market players to save resources, but also stimulate the development of resource-saving technical progress. Therefore, further reform of factor marketization is needed to reverse the phenomenon of price distortion and misallocation of factor and improve the overall production efficiency of the economy.

References


