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Empirical analyses on the development trend of non-ferrous metal industry under China's new normal

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Abstract. The CGE model of Yunnan's macro economy was constructed based on the input-output data of Yunnan in 2012, and the development trend of the non-ferrous metals industry (NMI) under the China's new normal was simulated. In view of this, according to different expected economic growth, and optimized economic structure, the impact on development of Yunnan NMI was simulated. The results show that the NMI growth rate is expected to decline when the economic growth show a downward trend, but the change of the proportion is relatively small. Moreover, the structure in proportion was adjusted to realize the economic structure optimization, while the proportion of NMI in GDP will decline. In contrast, the biggest influence on the NMI is the change of economic structure. From the statistics of last two years, we can see that NMI is growing, and at the same time, its proportion is declining, which is consistent with the results of simulation. But the adjustment of economic structure will take a long time. It is need to improve the proportion of deep-processing industry, extend the industrial chain, enhance the value chain, so as to be made good use of resource advantage.

1. Introduction

With the changes of domestic and international economic situation in recent years, China's economic development being the new normal has shown several characteristics, such as economic growth at a medium-high-speed, optimizing and upgrading economic structure, increasing challenges of economic development, and innovation-driven economic growth. Many scholars have studied the new normal at the aspect of the connotation and the trend [1], the characteristics and the concept [2], and the macro-control mode of supply and demand management [3, 4]. Moreover, regional and industrial research has been carried out in response to the impact of China's new normal, such as in heavy chemical industry and in western provinces [5, 6], and industrial readjustment and structural upgrading [7]. In view of the NMI, which is closely affected by the macroeconomic situation, there are few related studies, and the existing research focuses on qualitative rather than quantitative analysis.

Different types of non-ferrous metals have a good consistency in terms of metallic properties and price fluctuations, so it can be analyzed as a metal industry. In general, the production of NMI needs to go through mining, ore-dressing, smelting and processing, corresponding to two industrial sectors of the mining and processing of non-ferrous metal ores and the smelting and pressing of non-ferrous metals in Classification and Code Standard of National Economy Industry. Yunnan is an important



non-ferrous metal raw material supply base, and NMI has already become a pillar industry. Therefore, the development of NMI in Yunnan is typical representative of the development of NMI in China.

In this paper, the Yunnan Province is selected as the empirical case, and the relationship between the NMI and the various constituent sectors is constructed by using the Computable General Equilibrium model (CGE). Focusing on the medium-high economic growth, and the optimization of economic structure in China's new normal, the possible trends in the development of NMI are analyzed and provide supports for policy adjustments.

2. Methodology

There are interrelated and mutually restrictive market systems and price systems among social economic activities. The supply and demand for commodities tend toward equilibrium under the market mechanism function. This can be described by the CGE model.

2.1. Computable general equilibrium model

The general equilibrium theory is an economic theory used to study the equilibrium of price and output structure. The general equilibrium is formed when the supply and demand of each commodity or factors in the social price system are equal under certain conditions. CGE model is based on the general equilibrium theory [8]. The construction of static CGE model can be divides the markets relations into three blocks: supply block, demand block, and supply and demand block [9].

The supply system of the model can be divided into production supply and composite commodity supply. The production supply represents the relationship between the output and the factors, and between the output and the intermediate input. The producer behavior can be described by the Cobb-Douglas production function and the Constant Elasticity Substitution (CES) production function, and the intermediate input relationship can be described by the Leontief input-output matrix. Composite commodity supply refers to consist of different origins (production produced in province, in other internal region and imports) in the province market. Since the small inter-regional trade volume and small international trade volume will not cause changes in the market prices at home and abroad, Armington Assumption is generally used. The price of goods outside the province is set to be fixed, that is, assuming that province goods, domestic and international products are not completely replaced. And the import behavior is described with CES function.

The demand system of the model consists of consumers demand and allocation requirements. The consumer demand for commodities mainly refers to intermediate productions provided for enterprise production actions, consumption of residents and government, and investment. In the consumer behavior, the income of the inhabitants is derived from the factor endowment. The government not only appears as a consumer in the CGE model, but also develops policies that affect economic activity such as taxes, interest rates, exchange rates, tariffs, and subsidies. The allocation requirement mainly refers to the production produced in the province to meet the distribution among intraregional trade, interregional trade and export trade. The alternative relationship can be described by the Constant Elasticity Transformation (CET) function.

The supply and demand block is used to describe the equilibrium between the various markets or accounts. There is equilibrium in product market, that is, the total quantity and value of the aggregate supply of products in the market is equal to the quantity and value of the aggregate demand. There is equilibrium in factor market, that is, the total supply of factors is equal to the total demand. Investment is equal to the total savings, and in the main economic accounts, government revenue equals expenditure, corporate and household income equals expenditure, the balance of payments.

2.2. Data processing

In this paper, the CGE model is established on the reaction of Yunnan NMI under the China's new normal in the set of development goals or directions. The vast majority of the macroscopic data needed for the CGE model is derived from the input-output (I-O) table or the Social Accounting

Matrix (SAM). The SAM table is similar to the value-type I-O table, and is used to describe the flow relationship between macroeconomic variables.

Generally, a macroeconomic SAM table of an open economic system includes activities, commodities, factors (including labor and capital), household, enterprises, government, rest of world, investment [10]. As the proportion of Yunnan's export trade is small, and the import trade of NMI is less sensitive to exchange rate changes [11], the interregional trade and international trade can be simplified as a whole economic system of province outside. Therefore, the Yunnan SAM table is divided into 9 accounts: activities, commodities, labor, capital, household, enterprises, government, outside the region, and investment. The data of production activities, commodity trade, labor income and capital gains are mainly from the I-O tables of Yunnan Province 2012. The taxes, transfer payments and other data are mainly from Yunnan Statistical Yearbook 2013, China Statistical Yearbook 2013, China Taxation Yearbook 2013, and Finance Yearbook of China 2013.

3. Results

3.1. Development trend of NMI under medium-high economic growth

Yunnan economic growth showed a trend of first rise and then fall, the annual indices of gross regional product for 2006~2012 are above 10%, during which even reached 13.7% in 2011. With China's economic development into a new normal, economic growth is slowing down, and has been achieved from high growth to medium-high growth changes. Economic growth in 2014 is 8.1%, and in 2015 continues to maintain medium-high growth. NMI is closely affected by the macroeconomic situation, its growth volatility but gradually stabilized. Moreover, nonferrous metals industry in the proportion of the national economy showed a downward trend. The trend changes are shown in figure 1.

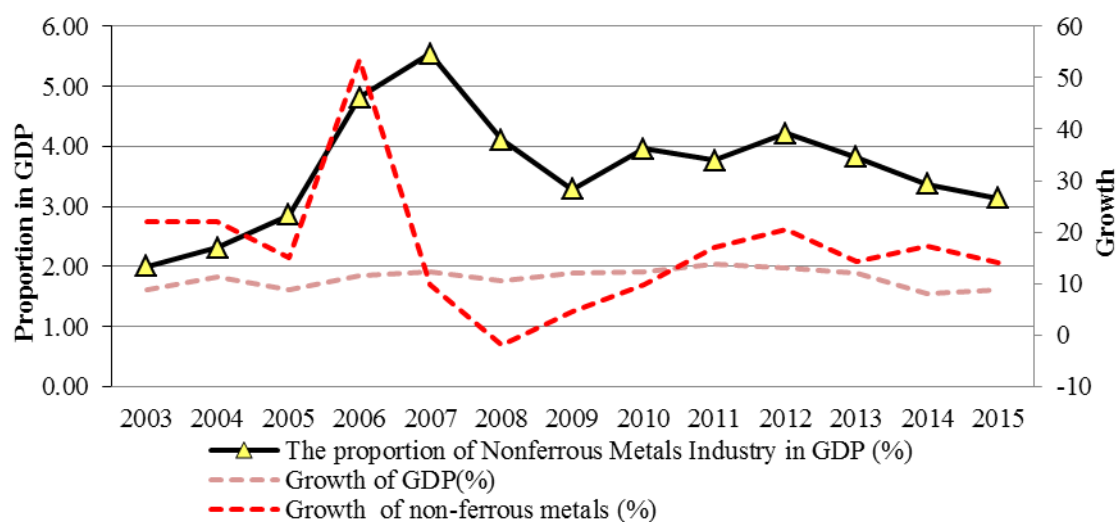


Figure 1. The development of Yunnan nonferrous metals industry.

With the implementation of China's industrial upgrading and adjustment strategy, the status of NMI in Yunnan's economic development has been changing. At current prices, 2013, 2014 and 2015 GDP were 114%, 124% and 132% respectively in 2012. After 2016, if the annual growth rate is expected to increase by 8%, then the gross domestic product in 2020 was 172% in 2012. According to the I-O table of Yunnan in 2012, the development of NMI industry under different expected economic growth (14% ~ 72%) were simulated. The simulation results are shown in table 1.

Table 1. NMI affected by economic growth expected.

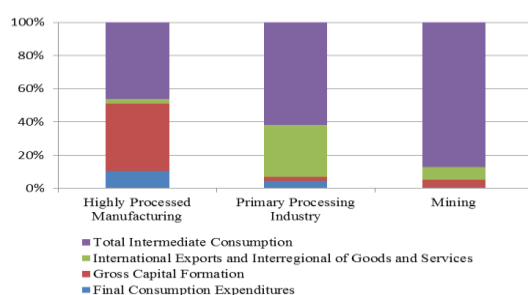
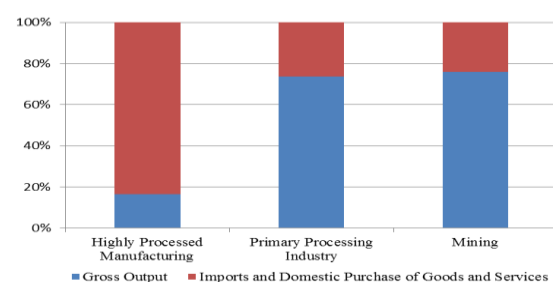
Expected economic growth (%)	Industrial added value(100 million yuan)	NMI as a proportion of GDP (%)	Expected economic growth (%)	Industrial added value (100 million yuan)	NMI as a proportion of GDP (%)
Initial value	432.7	4.15	40	403.19	2.76
14	434.58	3.65	48	402.85	2.61
24	414.94	3.20	64	410.08	2.39
32	407.73	2.96	72	415.82	2.31

It can be seen from the above table, under the industrial structure and technical conditions, with the improvement of economic growth, the metal industry showed the trend of increasing first and then down. The share of GDP is declining, accounting for a decline from 4.15% to 2.31% of the expected growth rate of 72%. However, due to the lack of technological progress in the role of economic development, the simulation results are lower than the real value, but compared to the status quo of economic development in Yunnan, the simulation results and NMI trends are generally consistent.

3.2. Development trend of NMI under economic restructuring

According to the I-O table of Yunnan 42 departments and 139 departments in 2012, Yunnan economic structure is divided into six major departments: Primary Industry, Mining, Primary Processing Industry, Highly Processed Manufacturing, Other Secondary Industry, Tertiary Industry, respectively, corresponding to the code 01, 02~05, 11~14, 15~21, 06~10 and 22~28, 29~42.

The recent situation of economic structure showed that highly processed manufacturing has the lowest proportion in Yunnan national economy. From the perspective of distribution of aggregate demand and composition of aggregate supply (see figure 2 and figure 3), highly processed manufacturing with high value-added show the phenomenon of high price to buy and low price to sell. There is overcapacity in primary processing industry, while insufficient in highly processed manufacturing. The economic structure needs to be upgraded and vigorously extend the industrial chain.

**Figure 2.** Distribution of aggregate demand.**Figure 3.** Composition of aggregate supply.

In order to analyze the trend of the development of NMI under the optimal adjustment of industrial structure, it is necessary to reduce the output of primary processing production and improve the output of reprocessing products. Therefore, it is possible to simulate the development trend of NMI under the decrease of the prices of primary processed products and the improvement of re-processing yield. According to the current situation of economic structure in Yunnan, the proportion of the initial processing sector is less than 10%, and the proportion of re-processed manufacturing sector is more

than 3% are regarded as the relatively ideal economic structure under the current technical level. The optimal solution in the simulation results is shown in table 2.

Table 2. Simulation results of economic structure change in Yunnan province.

Increase in output of Highly Processed products	Initial	20%	40%	50%	60%
Reduction in the price of Primary processed products	Structure	-10%	-26%	-31%	-36%
Primary Industry	16.1%	15.5%	16.4%	18.4%	16.9%
Mining	4.5%	3.5%	3%	3.6%	3%
Primary Processing Industry	11.1%	9.6%	9.7%	9.8%	9.8%
Highly Processed Manufacturing	1.5%	3.2%	4.7%	3.1%	4.9%
Other Secondary Industry	25.9%	28%	27.5%	26.6%	27.4%
Tertiary Industry	41%	40.2%	38.6%	38.5%	37.9%
NMI as a proportion of GDP	4.2%	2%	3.1%	5.8%	4.1%

Economic development requires that the industrial structure should continue to develop towards more advanced industries. In order to coordinate and optimize structure among the three industries, not too large to reduce the tertiary industry in the share of the national economy, and unnecessarily increase the proportion of the primary industry, when the output of reprocessed products increased by 20%, and the price of primary processed products fell to 10%, it is the most ideal industrial structure. At this point, NMI accounted for about 2% of GDP.

4. Conclusion

Based on the existing statistical data, this paper analyses the development and change of Yunnan NMI, and builds the static CGE model of Yunnan NMI under the macroeconomic changes based on the general equilibrium theory. Based on the premise of constant economic and technical conditions in 2012, this paper simulates the impact of Yunnan economy on the development of Yunnan NMI under the expectation of different economic growth, and economic restructuring. As can be seen:

(1) the proportion of Yunnan NMI in the national economy in 2014 is generally on the increase. With the economic slowdown, this proportion of NMI dropped significantly. The simulation results also show that the expected decline in GDP growth, NMI growth rate will show a downward trend, but the proportion changes less.

(2) from the economic situation of the six departments, we can see that the raw materials sector in the front of the industrial chain accounts for a large proportion of the economic composition, but the re-processing sector with high added value is small and gradually declines. Exports and exports to the province are mostly cheap initial processing products, a large number of imported or purchased more expensive reprocessing products, which resulted in the province's supply and demand does not match. The simulation results show that the optimization of the economic structure will reduce the proportion of NMI in economic structure, and the proportion is 2% in the relatively optimal economic structure.

In contrast, changes in economic structure have the greater impact on the NMI. In order to adapt to the new normal, the state and Yunnan Province introduced a series of policy measures. From the past two years of statistics can also be seen, the added value of NMI is in the increase while its proportion in GDP is declining, which is also consistent with the simulation results.

As the economic structure needs to undergo a long time to adjust before results can be seen, the statistical data in recent years also failed to fully reflect the change of industrial structure under the China's new normal. And the factors that affect the NMI are multifaceted, so only a slight comparison between the simulation results and actual results of the trend. It is necessary to establish a comprehensive model that encompasses multiple factors to more accurately simulate and compare.

Acknowledgments

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