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Article

Exploration of the Intersectoral Relations Based on Input-Output Tables in the Inland River Basin of China

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Abstract: The conflict among natural resources, environment and economic development is one of the major problems to be solved in the current world. Sustainable development is a powerful tool on the way toward seeking for harmonious development. Due to a lack of resources and fragility in ecosystems, the Inland River Basin of China is facing a serious problem that needs to be solved. In this paper, northwest China is chosen as the study area. Based on the interregional input-output table of China for the years 2002 and 2007 and the provincial input-output table of 2007, the I-O table analysis method was adopted to calculate the influence coefficient and response coefficient of the five provinces in northwest China. Through the analysis of the results, the intersectoral relation has been investigated, which could lend some credence for seeking effective ways for sustainable development in western China. The research findings indicate that the tertiary industry and construction sector are capable of greatly driving the national economic development in northwest China and, thus, should be developed preferentially.

Keywords: industrial structure; input-output table; sustainable development; influence coefficient; response coefficient

1. Introduction

With the sharp rise of the population and the rapid development of industry economics, humans are facing a series of severe problems of resources, environment and ecology [1,2]. More and more humans realize that there is a close relationship existing between environment and development. We cannot follow the traditional path of industrialization [3–5]. The path of sustainable development, which has a generic meaning here, was put forward by many developed countries, which proposes to develop new industries and transform traditional industries [6–8].

Over the past three decades of gradual economic reform and opening-up, the Chinese economy has gained rapid development. However, an extensive economic development mode has long been employed, which brought fast economic growth and, at the same time, caused resource depletion, as well as environmental pollution [9–12]. The development degree of industrial structure reflects the overall economic development of a nation. The state of sustainable development reflects the promising potential of the social and economic development of the entire nation. There are inseparable relationships between industrial structure adjustment and economic development [13–15]. The upgrading of the economic development level is synchronized with the rationalization of industrial structure.

The traditional economic growth mode of China focuses more on the development of energy-intensive and pollution-intensive industries, which has greatly damaged the ecological balance and goes beyond the bearing capacity of the environment [12,16,17]. The unsustainable development mode is facing a bottleneck in the further economic development in China. The traditional transformation mode of heavy reliance on secondary industry ought to be replaced by synergetic driving of all three industries. In this sense, it is significant to promote this synergetic transformation to a higher level and to raise the industrial technical level and international competitiveness. The industrial structure of China is changing from the "213" mode to "231" mode [18]. The "213" mode indicates that among all three major industries that constitute the industrial structure, the secondary industry takes the largest proportion, followed by the primary industry, with the rest being the tertiary industry. The concepts of industrial transformation and a low-carbon economy have been put forward and carried out recently from a global perspective. Additionally, we are facing an unprecedented environmental challenge in the process of economic development as serious resource and environmental problems. The most urgent thing for the right policy to be adopted is to adjust the industrial structure, as well as to develop the current economy to change the unsustainable industrial development mode. This is why we need to link industrial development with sustainable development.

The relationship between the principles of industrial structure and sustainable development has been explored quite extensively [19–21]. Ever since the 1930s, when Burns (1934) first brought about the famous industrial structure evolution law, many economists, including Kuznets (1994), have done more thorough investigations on the evolution of industrial structure and industrial structure adjustment [22,23]. With the deepening of the research, more and more attention has been paid to the issue of industrial structure, which has brought about more and more serious environmental problems, further driving more research scientists into this research field and making it become a hot issue from a multidisciplinary perspective [24,25]. So far, most of the research is confined to qualitative analysis, with less researchers doing quantitative analysis [26–30]. In this paper, we would like to do a quantitative analysis on this issue through the I-O analysis method. More often than not, many researchers directly set sustainable development as the goal and adjust the industrial structure for sustainable development, giving less concern to the self-evolution law of industrial structure [31]. The advantage of using I-O analysis is that it could draw the production-related association among all of the national sectors, which is also the novelty of this research. Besides, the structure of the I-O table is very suitable for sector analysis. As we know, there is no pure free market in China, but many empirical studies using I-O analysis in China give us proof to show that China's freeness degree and openness degree is enough for us to use the I-O analysis method. Furthermore, this is the very reason that our government should regulate and control the economy, but this kind of interference is not random, which is why we study the development under free conditions and make scientific and reasonable policy recommendations based on our conclusions, which is also the purpose of our research. In addition, we give full consideration of the characteristics of different industries and their evolution law, which could provide a certain reference for the realization of industrial transformation and structure optimization to achieve the ultimate goal of sustainable development.

In this paper, the influence coefficient and response coefficient were first calculated on the basis of the I-O analysis method. Then, combined with the current situation of the northwest region, the interrelationship of the industrial structure and sustainable development was investigated through analyzing the stimulation effect of different industrial sectors on the economy and the influence from other sectors. The suitability of the sustainable development strategy on the current development trend of China's industrial structure was also analyzed. The research result will provide a valuable reference for adjusting the industrial structure towards sustainable development.

2. Materials and Methods

2.1. Study Area

Even though the Inland River Basin of China is a place with a low speed of development in comparison to the national average, the fragile ecosystem has suffered greatly from economic development recently [32]. In this study, we focus our case study on the northwest region, which is an arid and half arid area and is one of the three physical geographic regions of China. It covers five provinces, including Shaanxi, Qinghai, Gansu, Ningxia and Xinjiang, with an area of about 30.93 million square kilometers, and accounts for 32.2% of the total area of China. This region is sparsely populated, arid and lacking water with a fragile ecological environment. However, this region is rich in land, energy and mineral resources, with huge potentials for development. Especially, the land, coal, oil, natural gas, nonferrous metals and salt lake resources share large proportions of those in the whole nation, making this region an important reserve base for guaranteeing the sustained development of the national economy.

The industrial structure in the northwest region is characterized by a "231" mode, with the secondary industry taking the larger proportion and still increasing. From 2002 to 2007, the proportion of secondary industry in the northwest region increased from 52% to 65%, which is higher than the proportion at the national level (Figure 1); while the proportions of the primary and tertiary industries were both decreasing by 9% and 4% in 2002 and 2007, respectively. The proportions are lower than those of the primary and tertiary industry at the national level. The nation presents a "231" industrial structure mode on the whole, with no obvious change from 2002 to 2007.

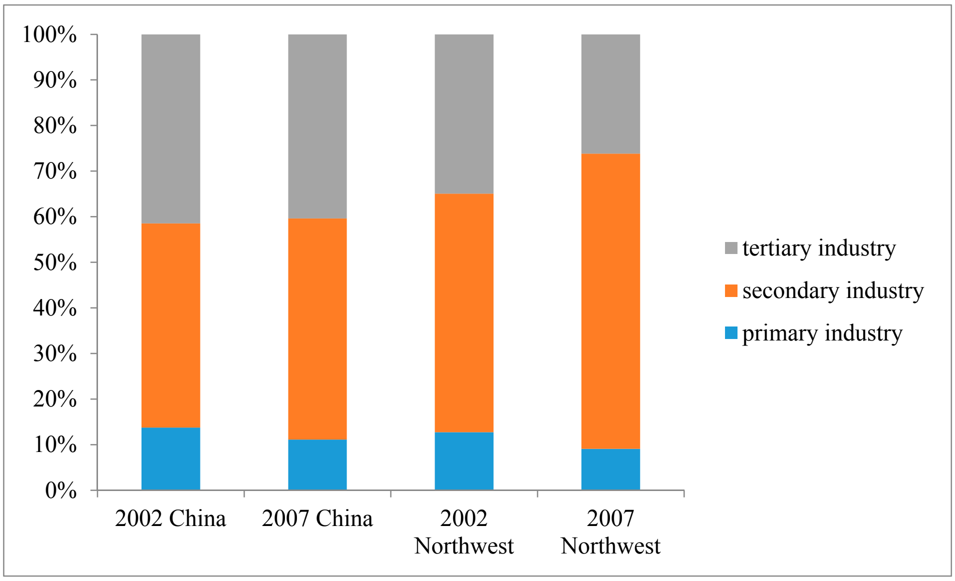


Figure 1. Industrial structure in China and the northwest region, 2002 and 2007.

We further divided the secondary industry into 14 sectors, acquiring an industrial structure with 16 sectors (Figure 2). In the secondary industry, the GDP of some sectors was increased, while in other sectors, decreased. Among them, the most obvious increase occurred in the mining and quarrying sector, metal products sector and industrial chemicals sector, with an increase of 4.3%, 3.9% and 2.4%, respectively. Besides, the GDP proportion of the electricity, gas and water production and supply sector, food, beverages and tobacco and transport equipment sector increased to different extents; while the most obvious decrease occurred in the construction sector, decreasing by 1.5%. There are also minute decreases in the paper, paper products and printing sector and electric apparatus and communication equipment and other manufacturing sector.

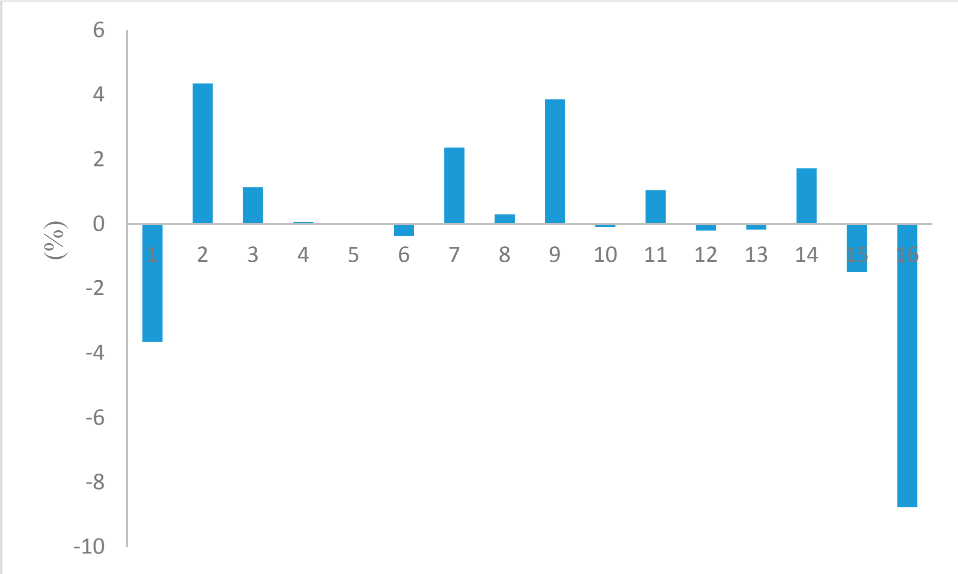


Figure 2. Percentage change of the industrial structures (%) in northwest China, 2002 to 2007. Note: the 16 numbers in the horizontal axis represent the 16 industrial sectors respectively. 1 for primary industry; 2 for mining and quarrying sector; 3 for food, beverages and tobacco sector; 4 for textiles, apparel and leather sector; 5 for wood products and furniture sector; 6 for paper, paper products and printing sector; 7 for industrial chemicals sector; 8 for non-metallic mineral products sector; 9 for metal products sector; 10 for machinery and equipment sector; 11 for transport equipment sector; 12 for electric apparatus and communication equipment sector; 13 for other manufacturing sector; 14 for electricity, gas and water production and supply sector; 15 for construction sector; and 16 for tertiary industry.

The five provinces of northwest China are geopolitically adjacent to each other. They are all rich in resources with a similar industrial structure. There is rapid economic development in the five provinces. The current economic development structure is between the level of the low-income countries and middle-income countries of the world. Ever since China's western development, the industrial structure of the five provinces have been characterized by agricultural labor form the majority of the population; the secondary industry contributes most to the output value, and the service industry is enlarging. Figure 3 shows the industrial structure of the five provinces with 26 sectors in 2007. The industrial structure in all five provinces presents the "231" mode. Among all of the sectors in the secondary industry, the construction sector took the largest proportion in Shaanxi, Ningxia and Qinghai. In Gansu, the metal smelting and rolling products sector took the largest GDP proportion; while in Xinjiang, the petroleum and gas extraction sector took the lead.

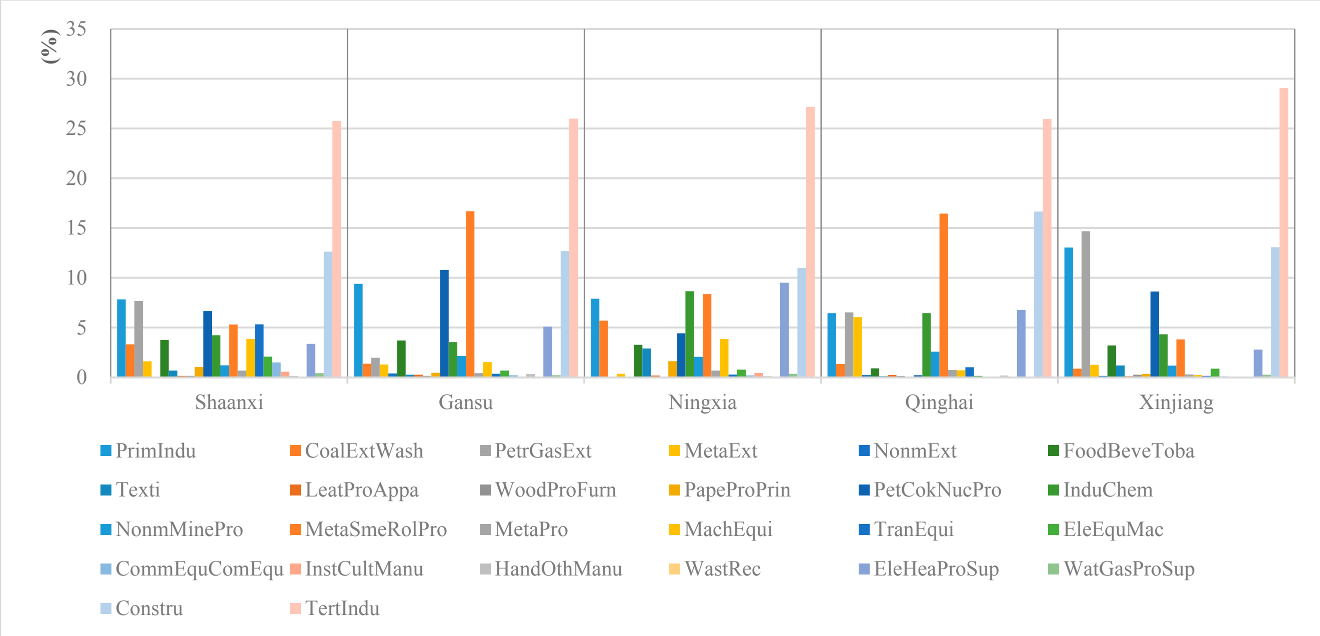


Figure 3. Percentage of the industrial structure (%) of the five provinces of northwest China in 2007. Note: The 26 abbreviations in the horizontal axis are short for the 26 industrial sectors, respectively. PrimIndu represents for primary industry; CoalExtWash represents for coal extraction and washing sector; PetrGasExt represents for petroleum and gas extraction sector; MetaExt represents for metal extraction sector; NonmExt represents for non-metal extraction sector; FoodBeveToba represents for food; beverages and tobacco sector; Texti represents for textile sector; LeatProAppa represents for leather products and apparel sector; WoodProFurn represents for wood products and furniture sector; PapeProPrin represents for paper; paper products and printing sector; PetCokNucPro represents for petroleum; coking and nuclear fuel products sector; InduChem represents for industrial chemicals sector; NonmMinePro represents for non-metallic mineral products sector; MetaSmeRolPro represents for metal smelting and rolling products sector; MetaPro represents for metal products sector; MachEqui represents for machinery and equipment sector; TranEqui represents for transport equipment sector; EleEquMac represents for electric equipment and machinery sector; CommEquComEqu represents for communication equipment; computers and other electronic equipment sector; InstCultManu represents for instrumentation and cultural office machinery manufacturing sector; HandOthManu represents for handicrafts and other manufacturing sector; WastRec represents for waste recycling sector; EleHeaProSup represents for electricity and heat production and supply sector; WatGasProSup represents for water and gas production and supply sector; Constru represents for construction sector; TertIndu represents for tertiary industry. The categories are different from Figure 2 because we used the refined data industries of the five provinces.

2.2. Data

In order to make a comparative analysis, two kinds of I-O tables are used in this study, the regional ones and the provincial ones. The regional I-O tables of 2002 and 2007 are used to analyze the industrial structural transformation and the sustainable development in the whole of northwest China, which are compiled by the State Information Center [33]. Sixteen sectors are include in the regional I-O tables: 1 is in primary industry; 1 is in the mining and quarrying sector; 4 of them are in light industry; 7 of them are in heavy industry; 1 in the electricity, gas and water production and supply sector; 1 in the construction sector; and 1 in another tertiary sector. China is divided into eight regions based on geographic, agro-climatic and demographic characteristic and economic development levels, while the regionalization is consolidated with provincial-level administrative boundaries in the regional input-output tables.

The provincial I-O tables of the five provinces of northwest China are also used in our study; they are used to make a similar analysis at the level of each province, which are compiled by the State Statistical Bureau of China [34]. Within the regional I-O tables of each province of northeast China, categories of the industrial sectors are kept consistent and comparable with each other based on the system of national accounts. There are 42 sectors in the provincial I-O tables, and among these sectors, 1 is in primary industry, 24 are in secondary industry, 1 in the construction sector, 1 in the transport and communication and warehousing sector and 15 are in other tertiary sectors. For the need of analysis and for the convenience of calculation, we merger the 16 service sectors into 1 tertiary sector and combine the 24 sectors and 1 construction sector into 24 secondary industry sectors; therefore, we got 5 provincial I-O tables with 26 industrial sectors.

2.3. I-O Table Analysis

The I-O table analysis method is a comprehensive research method. It assimilates the core idea of the correlation among economic activities in the general equilibrium theory and mainly analyzes the quantified ratio technical economic ties among different economic sectors. It depicts the dynamic flow of a product or service in a given area of economic sectors. Through compiling a checkerboard type I-O table and setting up a corresponding system of linear algebraic equations, this method builds an economic mathematical model to simulate the social reproduction process in the real national economic system. It analyzes the detailed statistics of the whole economic system under an economic theory framework and reveals quantified ratio technical economic ties among different economic sectors.

The influence coefficient and response coefficient are the two important coefficients in the I-O table analysis. In the research of modern industry, it is one of the classical methods to analyze the response and influence coefficient from the perspective of the industrial chain based on the I-O table. In this study, we define the status of the sector according to its response and influence coefficient. Taking the output value proportion factor and the contribution to the national economy via units of output into comprehensive consideration could better reflect the status of industrial sectors in the whole national economy and the pulling effect on other industries.

In this study, based on the traditional input-output table (Table 1), we built the input-output analysis model. Four kinds of coefficients are calculated in the process of I-analysis in order to analyze the relationship between industries and sustainable development, the direct consumption coefficient, the full demand coefficient, the influence coefficient and the response coefficient.

Table 1. The fundamental form of the I-O table.

		Intermediate use 1 2 …… n	Final demand	Gross output
Intermediate input	1 2 …… n	X_{ij} Quadrant I	Y_i Quadrant II	X_i
Value added		N_j Quadrant III	Quadrant IV	
gross input		X_j		

The direct consumption coefficient is calculated by the following formula:

$$a_{ij} = \frac{x_{ij}}{X_j}(i, j = 1, 2, \ldots n) \tag{1}$$

while the direct consumption coefficient matrix is expressed as:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \tag{2}$$

Equation (3) establishes the connection between production and gross output:

$$\sum_{j=1}^{n} a_{ij} X_j + y_i = X_i (i = 1, 2, \cdots, n) \tag{3}$$

Then, we fit the direct consumption coefficient in Equation (3) and express (3) in matrix form; we get:

$$AX + Y = X \tag{4}$$

Therefore, Equation (4) can be written as:

$$Y = (I - A)X \tag{5}$$

where *I* is the unit matrix, and *(I − A)* is the so-called Leontief multiplier matrix.

From further deformation of Equation (5), we get the fowling equation:

$$X = (I - A)^{-1} Y \tag{6}$$

where $(I - A)^{-1}$ is the full demand coefficient matrix (B matrix), which means the gross demand value of gross output from the unit of final production; it can be expressed as:

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix} \tag{7}$$

2.4. Inter-Industrial Linkage Analysis

As we know, the essence of inter-industrial linkage is the demand and supply relationship among different sectors. Hence, in this study, we conducted the inter-industrial analysis by analyzing the backward linkages and the forward linkages. Backward linkages are linked with other industrial sectors through demand, and forward linkages are through supply to connect with other sectors in the whole of the national sectors. They are key indicators to evaluate the interdependence among sectors. For convenience, we normalized the backward linkages and forward linkages in the process of inter-industrial linkage analysis.

The normalized backward linkages in the I-O analysis are defined as follow:

$$r_j = \frac{\sum_{i=1}^{n} \bar{b}_{ij}}{\frac{1}{n}\sum_{j=1}^{n}\sum_{i=1}^{n} \bar{b}_{ij}} \quad (j = 1, 2, \ldots n) \tag{8}$$

where $\sum_{i=1}^{n} \bar{b}_{ij} (j = 1, 2, \ldots n)$ represents the influence of j industry sector, which means the demand for the gross output of the national economic sectors from j industry sector per increase of the unit of final output. Additionally, $\frac{1}{n}\sum_{j=1}^{n}\sum_{i=1}^{n} \bar{b}_{ij} (j = 1, 2, \ldots n)$ means the social average influence. The backward linkages, which are also known as influence coefficients, are often used in analyzing the pulling effect of industrial association. The greater the value of r_j, the stronger the influence j industry sector holds. If $r_j = 1$, then the influence of j industry sector is equal to the social average influence, which means the influence of j industry sector is neutral; if $r_j > 1$, then the influence of j industry sector is greater than the social average influence, which means the influence of j industry sector is promoted; If $r_j < 1$, then the influence of j industry sector is less than the social average influence, which means the influence of j industry sector is slackened.

Similarly, the forward linkages are defined as follows:

$$s_i = \frac{\sum_{j=1}^{n} \bar{b}_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} \bar{b}_{ij}} \quad (j = 1, 2, \ldots n) \tag{9}$$

where $\sum_{j=1}^{n} \bar{b}_{ij} (i = 1,2 \ldots n)$ represents the response of i industry sector, which means the increase output of I industry sector when the gross final output of the national economic sectors increases by a unit. Additionally, $\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} \bar{b}_{ij} (j = 1, 2, \ldots n)$ means the social average response. The forward linkages, which are also known as the response coefficient, can be used to analyze the industrial correlation pulling effect. The more intermediate use value an industry sector can supply to other sectors, the greater value of the response it holds. If $s_i = 1$, then the response of i industry sector is equal to the social average response, which means the response of i industry sector is neutral; if $s_i > 1$, then the response of i industry sector is greater than the social average response, which means the response of i

industry sector is a strong restriction; if s_i < 1, then the response of *i* industry sector is less than the social average response, which means the response of *i* industry sector is a weak restriction.

If we took the influence coefficients and response coefficients of one sector comprehensively into consideration, we can get the pulling effect and the sustaining effect of this sector on the whole national economy. There are four kinds of effects:

(1) $r_j > 1$, $s_i > 1$: This kind of sector is highly radioactive and crucial and has both a pulling and sustaining effect on the national economy. One example might be the construction sector.
(2) $r_j > 1$, $s_i < 1$: This kind of sector is highly radioactive and less conditional, which has a high pulling effect and a low sustaining effect. Examples might be the consumer and food sectors.
(3) $r_j < 1$, $s_i > 1$: This kind of sector is less radioactive and highly conditional, which has a high sustaining effect and little pulling effect. Those sectors are likely to be in the upstream link in the industrial chain, like electricity, coal, petroleum and steel sectors, *etc.*
(4) $r_j < 1$, $s_i < 1$: This kind of sector is less radioactive and conditional and has both a low sustaining and pulling effect. One example might be the science-education-culture-health sector.

Above is the I-O analysis model of northwest China that we built through the I-O table with the water withdrawal account, which we can use to analyze the mutual influence between the national economy increase and the water use efficiency of industry sectors and to research the input-output relationship between the gross output and gross demand of the macro-economy and the water use efficiency of industry sectors.

3. Results and Discussion

Based on the aggregated 16-sector I-O table of China in 2007 and 2002, and the 26-sector provincial level I-O table of the five northwest provinces in 2007, the influence coefficient and response coefficient were calculated by the I-O analysis method. Then, we could get the characteristics of the sectors in the present in the process of development through these analyses. This could provide a direction for industrial structure adjustment.

3.1. The Coefficients of Northwest China

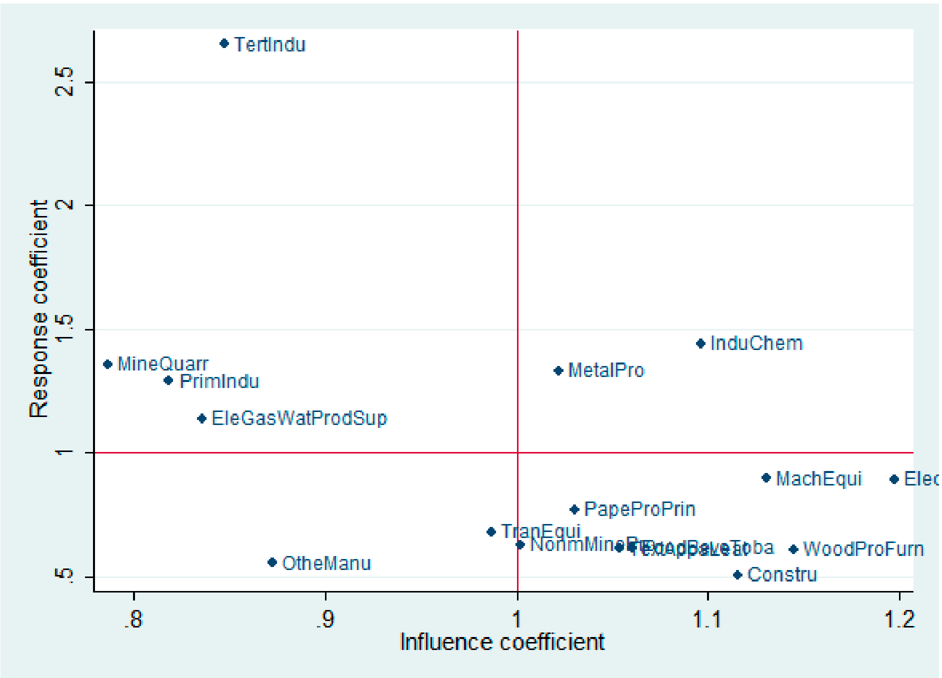
In terms of the influence coefficient (Figure 4), there are 10 out of 16 sectors whose influence coefficient is higher than one. These sectors are mainly concentrated in the manufacturing industry, with the top three being the electric apparatus and communication equipment sector, machinery and equipment sector and construction sector. This shows that these industries have a greater influence on the national economy, which is above the average influence level.

In terms of the response coefficient, there are six out of 16 sectors whose response coefficient is higher than one, which shows that these sectors have a higher than average sensibility of and driving force on the national economy. Among them, the tertiary industry has the largest response coefficient of 2.65, which shows its high sensibility of and pulling effect on the national economy; while both the industrial chemicals and metal products sectors have a higher than one influence and response coefficient, which shows that these two sectors have a high pulling and sustaining effect on the national economy (Figure 4a).

According to the calculation results of 2007, in terms of the influence coefficient, there are 10 out of 16 sectors whose influence coefficient is higher than one. These sectors are still mainly concentrated in the manufacturing industry, which shows that these industries have a higher than average level of influence on the national economy. Among them, the transport equipment sector, construction sector and machinery and equipment sector have the highest coefficient, which is a little different from the situation in 2002.

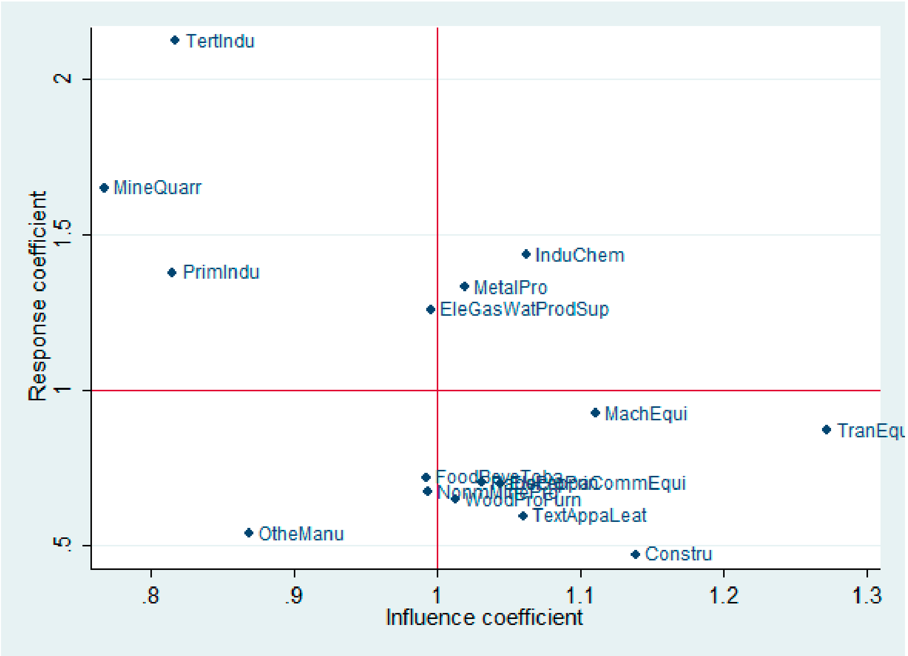
In terms of the response coefficient, the values are similar in 2007 and 2002, with six sectors higher than one, which shows that these sectors have a higher than average sensitivity to and pulling effect on the national economy. The largest response coefficient still occurred in the tertiary industry, while the value in 2007 is lower than that of 2002, being 2.12. In 2007, the industrial chemicals sector and metal products sector still have a higher than one influence and response coefficient, but the value is lower than that of 2002, which shows that, though these two sectors still have a high pulling and sustaining effect on the national economy, these effect have been weakened. In the electricity, gas and water production and supply sector, the response coefficient in 2007 is higher than one, and at the time, the influence coefficient is near one (0.99). Both are higher than in 2002, which shows that these sectors have taken some of the industrial chemicals and metal products industries jobs to pull and sustain the national economy (Figure 4b).

Taking the calculation results of 2002 and 2007 into comparison, we can find that the number of sectors whose influence and response coefficients are both higher than one increased. This shows that the industrial adjustment of northwest China is positive in pulling and sustaining the national economy. Besides, the response coefficient of the machinery and equipment sector and primary industry have increased, which shows that the pulling effect of these two sectors has increased (Figure 4).



(a)

Figure 4. *Cont.*



(**b**)

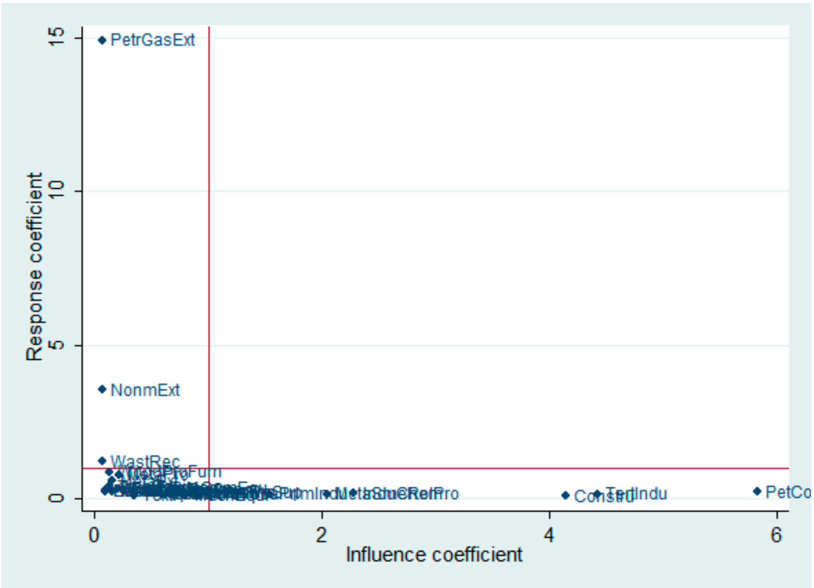
Figure 4. Influence coefficient and response coefficient for the year 2002 (**a**) and 2007 (**b**) in northwest China.

3.2. Estimated Influence and Response Coefficients

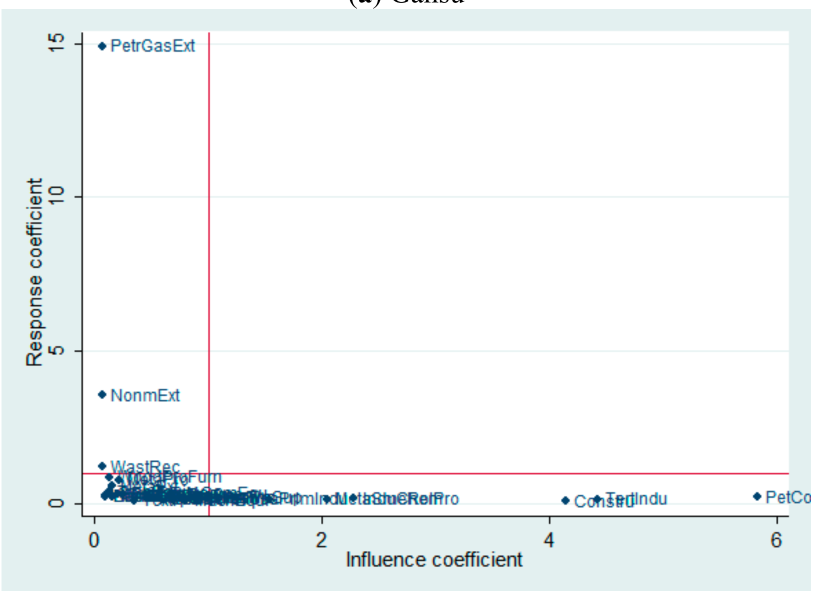
Based on the I-O table of the five provinces in northwest China, the response and influence coefficient are calculated (Figure 5). We can see that due to different industrial structure and features, the distribution, the response and influence in each sector is different in each province. In Gansu, there are seven out of 26 sectors whose influence coefficient is higher than one, with the top two being tertiary industry and the construction sector. Their values are 4.64 and 4.62, respectively. There are eight sectors whose response coefficient is higher than one, but there is no sector that has both a higher than one influence and response coefficient; while the two coefficient in the rest of sectors are all lower than one (Figure 5a).

In Ningxia, there are six out of 26 sectors whose influence coefficient is higher than one, with the largest being 5.83 in the petroleum, coking and nuclear fuel products sector. The other two sectors with a large coefficient are the tertiary industry and construction sector, with the values being 4.42 and 4.15. There are only three sectors whose response coefficient is higher than one, which are the petroleum and gas extraction sector, non-metal extraction sector and waste recycling sector; while in all other sectors, the two coefficients are lower than one (Figure 5b). In Gansu, there are six out of 26 sectors whose influence coefficient is higher than one, with the top two being the construction sector and tertiary industry. The values are 7.88 and 3.01, respectively. There are four sectors whose response coefficient is higher than one. The non-metal extraction sector and waste recycling sector have the largest response coefficient, 6.19. In other sectors, the response and influence are both lower than one (Figure 5c).

The situations in Qinghai and Xinjiang are similar as the other three provinces: there is no sector whose response and influence coefficient are higher than one. This has something to do with the fine divide of the secondary industry. In Qinghai, there are six out of 26 sectors whose influence coefficients are higher than one; besides the tertiary industry and construction sector, the influence coefficient in the metal smelting and rolling products sector is also relatively higher. In terms of the response coefficient, there are six sectors whose response coefficient is higher than one. They are mainly concentrated in the paper, paper products and printing sector, petroleum, coking and nuclear fuel products sector and waste recycling sector (Figure 5d). In Xinjiang, there are five out of 26 sectors whose influence coefficients are higher than one. Besides the construction sector and tertiary industry, the metal smelting and rolling products sector also has a relatively higher influence coefficient. What is more, the influence coefficient in the primary industry is higher than one, which is different from the situation in the other four provinces. There are five sectors whose response coefficient is higher than one, with the largest in the waste recycling sector (Figure 5e).

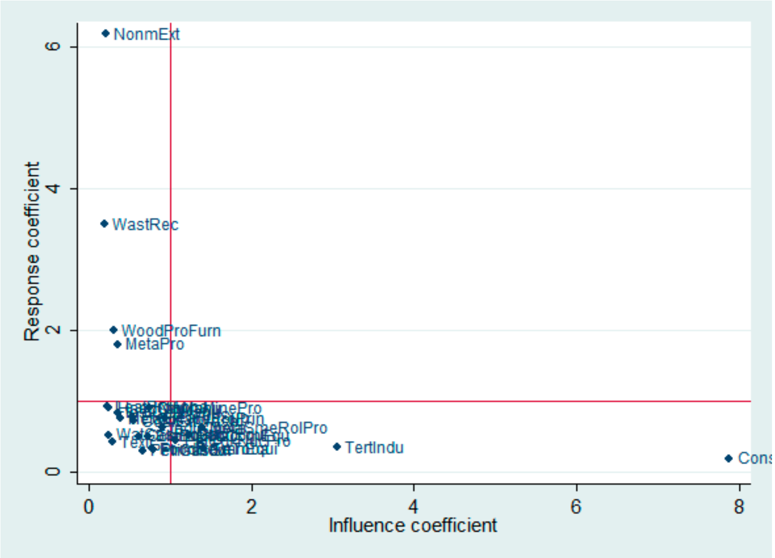


(**a**) Gansu

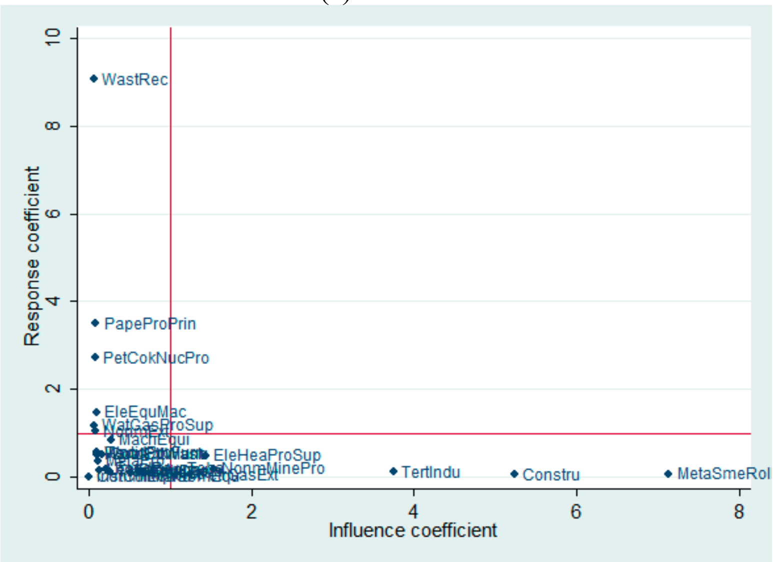


(**b**) Ningxia

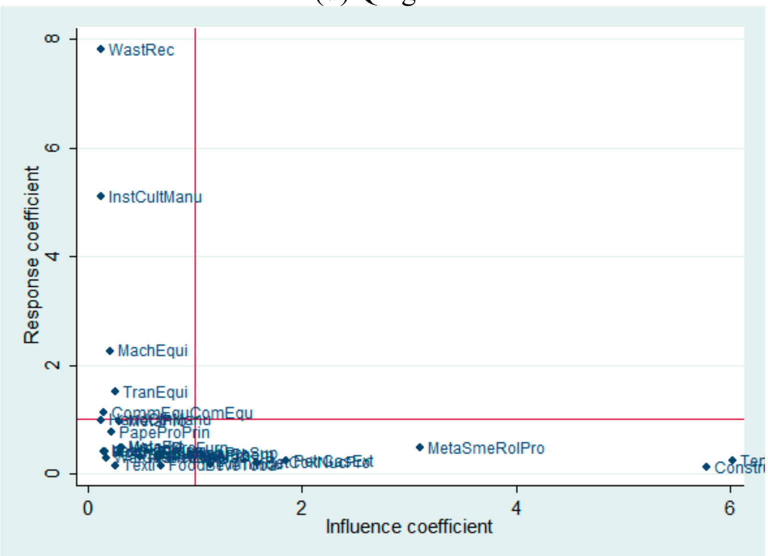
Figure 5. *Cont.*



(**c**) Shaanxi



(**d**) Qinghai



(**e**) Xinjiang

Figure 5. Influence coefficients and response coefficients of the five provinces of northwest China in 2002 and 2007.

4. Conclusions

It is always a puzzle to make and choose industrial policies in the process of economic development. It is not only decided by history, geography and resource conditions, but also by the economic development level and industrial structure; which means the quantitative analysis of inter-industrial linkage in northwest China is relevant to its future sustainable development policy making. In conclusion, in the northwest region, the industrial chemicals sector, metal products sector and electricity, gas and water production and supply sector have certain effects, pulling the development of other industries and promoting local economic development, therefore having a certain sustaining effect on the national economy. Besides, from the provincial level, in the five provinces in this region, the tertiary industry and construction sector could greatly pull national economic development. The prosperity and stability of these industries are crucial to the development and stability of the macro-economy.

As we know, policy implications must be based on both the past and current research; policy makers should therefore pay attention to both historical facts and future development trends, but the findings and conclusions we got from the whole analysis have already given our government enough proof and hint to do a little adjustment of the industrial structure to make it more reasonable. We have seen the unsuitable pace of the present industrial structure, so there is no need to predict an unreasonable industrial structure in the future; besides, we are under adjustment. Therefore, based on the above research findings, some policy preferences could be reached. On the one hand, the internal structure of the three main industries should be optimized, to alter the current "231" mode to the "321" mode—"231" mode means the rank of the percentage of the three major industrial sectors is the secondary industry, the tertiary industry and the primary industry; similarly, "321" mode means the rank is tertiary industry, the secondary industry and the primary industry. On the other hand, the proportion of tertiary industry in the whole national economy should be steadily increased. Similarly, the proportion of the industries that have little pulling or sustaining effect on the national economy should be steadily decreased. It is worth noticing that, from the perspective of the whole national economy, moderately developing the tertiary industry guarantees the coordinated development of all of the other industries and avoiding the bad effect caused by severe industrial structure adjustment.

Specifically, the secondary industry is highly dependent on the resources in this region for its mining and other related activities. As a result, stability in the industrial structure is quite low. The dominant sectors there mainly rely on local mineral and energy resources. After several decades of exploitation, resources are facing exhaustion. Therefore, there is an urgent need to adjust the industrial structure into a sustainable development mode. Besides, it is worth noticing that the adjustment of the industrial structure should follow certain principles, depending on which development stage the economy is in and taking China's current national conditions and the actual situation of northwest China into consideration. Besides, the issue of industrial transformation under the guidance of sustainable development is a periodic issue in the process of economic development. To further investigate this issue, researchers should start from the general principle of the industrial transformation and understand the rationale of separating different development stages, then define what development stage we are in and predict the future trend of the industrial development based on the real situation.

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Author Contributions

Xiangzheng Deng designed the research and went through all sectional works. Qingling Shi performed the research, analyzed the data and wrote the paper with results checking. Shiyi Chen gave review suggestions for the manuscript on the whole writing process. Chenchen Shi collected the original data and background materials, analyzed the data, drew the figures and polished the expression. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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