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Research Article

Study on the Level of Integration of Equipment Manufacturing Industry and Producer Service Industry in the Region Transforming Provinces and Its Influencing Factors: Taking Shanxi Province as an Example

Tao Ding, Guoxin Bai, and Han Xu

School of Economics and Management, Taiyuan University of Science and Technology, Taiyuan 030024, Shanxi, China

Correspondence should be addressed to Tao Ding; 20152911317@stu.qhnu.edu.cn

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At present, China's equipment manufacturing industry and producer service industry are gradually ushered in the leapfrog high-quality development of the rising period. It is particularly important how Shanxi, as the vanguard of the transformation and development, positively responds to the national call to break the shackles of the current integrated development of equipment manufacturing and producer services, for Shanxi Province and even the country's future industrial integration, transformation, and upgrading to accumulate "Shanxi Experience." Therefore, this paper measures and analyzes the integration level of equipment manufacturing and production services between 2012 and 2017 using the input-output method. Then, by constructingthe model of the factors influencing the integration of Shanxi's equipment manufacturing industry and producer service industry, selecting the relevant indicators and bringing in the relevant data from 2009 to 2019, by using the principal component regression analysis method, and thus clarifies the main factors that influence the convergence of the equipment manufacturing industry and production service industry in Shanxi. Finally, this paper has provided targeted countermeasures and suggestions to further promote the integration of the two industries in Shanxi Province.

1. Introduction

As a core sector of the national industrial system, equipment manufacturing is the fundamental for us to achieve the "Chinese dream," and to improve our Comprehensive National Power and international competitiveness. As an important part of the modern service industry, producer services are the supporting service sector for enterprise production, commercial operation and social development, equipment manufacturing industry, and other industrial sectors indispensable to the important cooperation and complementary sectors. Nowadays, the world is going through the biggest change in a century, in particular, under the test of the global epidemic in 2020, the interconnectedness and interdependence of the global regions have become more prominent, and the economies of all countries have been hit hard to varying degrees. However, among other countries, China has taken the lead in the recovery of manufacturing and service industries and putting the economy back on the right track. At the same time, with the publication of relevant documents such as the 14th Five-Year Plan for Economic and Social Development of the Nationality Law of the People's Republic of China and the outline of vision 2035 and the views on accelerating the high-quality development of manufacturing services, it proves that China's equipment manufacturing industry and producer service industry are striding into the sequence of high-quality development.

Shanxi, a significant educational and resource province, has taken steps to support the growth of producer services and has seen some success in doing so. The promotion of deep manufacturing and service industry integration and the development of service manufacturing are key strategic goals of the Shanxi provincial initiative "China produced 2025." In

Shanxi, the added value of producer services increased by more than four times between 2004 and 2014. The value added by the financial, retail, and transportation sectors rose by 9.5, 3.5, and 1.5 times, respectively. The financial sector is growing the fastest, and its yearly growth rate is far faster than the province's overall level of economic activity. Although Shanxi's productive service sector is quickly expanding, there are still a number of issues, including tiny businesses, a shaky foundation, and a lack of understanding of innovation. Additionally, it directly contributes to the promotion and integration of the manufacturing sector. Thus, for Shanxi Province, a model of the rise of central China and a leader in the transformation of energy cities across the country, if it wants to continue to forge its own path of transformation in this highly competitive and fast-changing international environment, it is necessary to make clear the integration level of equipment manufacturing industry and producer service industry and its main influencing factors in order to promote these two industries to become an important pulling force for local economic development.

This paper is organized into five sections. Section 1 presents the introduction, and section 2 highlights the related study. Section 3 focuses on the empirical analysis, and section 4 presents the evaluation index of the study. Section 5 presents the conclusion and enlightenment.

2. Literature Review

The concept of "industry convergence" originated from the "technology convergence" phenomenon discovered by American scholar Rosenberg [1] in the study of the evolution of the American machine tool industry in 1963; according to this, it is pointed out that industrial convergence is the process of technology diffusion and convergence to different industries. Since then, with the innovation of computer technology, digitalization and informatization have gradually become the focus of discussion. In 1978, Negreouponte systematically described the technological boundary among computer, print publishing, and radio and television industry, and further found that the intersection of these three industries is the most concentrated place of enterprise innovation and development, which leads to the industrial boundaries of the vague idea, and for the subsequent interaction of industries to lay a preliminary theoretical foundation. Then, in the late 1990s, the pace of academic research on industrial convergence continued to increase, and foreign Scholars Geum et al. [2], Kim et al. [3], Abreu and Mendes [4], and others have explained and analyzed the concept from different dimensions such as technology, representation, and process. At the same time, although the initial research on industrial convergence in China is still relatively late compared with that in foreign countries, a large number of domestic scholars such as Xin [5], Zhou and Ning [6], Su et al. [7], and so on have also conducted supplementary studies from these three dimensions, so that the connotation of industrial integration is a more rich and more perfect theoretical system.

As for the influence factors of the integration of equipment manufacturing and production services, most domestic and foreign scholars focus on the internal and external factors. Van Der Merweren [8] argues that the level of integration between manufacturing and production services is mainly driven by customer demand. By studying the service types of service-oriented equipment manufacturing industry, Ren [9] points out that the service strategy of manufacturing industry will be influenced by the change in its external business environment, and these changes include the continuous and significant pressure of interfirm product competition, the increasing demand for customer value, and the increasing demand for profit. Leiponen [10] through the empirical analysis of the factors influencing the integration of the manufacturing and the service industries in Finland, it is found that the difference in R&D efficiency between the manufacturing and the service industries affects and promotes the integration of the two industries. Li [11] by discussing the internal and external conditions of the development and upgrading of equipment manufacturing industry, this paper further expounds the relationship between equipment manufacturing industry and production service industry, and points out the relevant influencing factors, including policies, funds, etc. Wang and Li [12] analyze the main influencing factors of the service level of China's manufacturing industry from the angles of input and output, including market competitive intensity, service economy level, resource dependence degree, enterprise market structure, capital distribution structure, enterprise scale, service business profit level, etc., and empirical analysis of various factors in promoting the transformation of manufacturing services.

In addition, scholars also focus on the equipment manufacturing and producer service integration model. As early as the 1980s, with the gradual rise and expansion of the information industry, some enterprises began to combine and apply it to the construction of enterprise information systems; as a result, the production process becomes more efficient and transparent; and the manufacturing process becomes more flexible and complex. Aiming at this situation, Vandermerve and Rada first put forward the integration mode of "manufacturing service," after which a large number of scholars devoted themselves to the study of this mode. Garciam [13] studies the development process of the service industry and the manufacturing industry, and considers that modularization and coordinated development are the best models for the integration and development of the two industries. Taking the general group as an example, Gebauer et al. [14] illustrate that service-oriented manufacturing is one of the important means of industrial convergence, which can promote the interactive development of the two industries. He and Sun [15] further improve and deepen the concept and attributes of service manufacturing on the basis of previous studies, and emphasize the objective importance of the development of manufacturing industry in China under the current situation; on this basis, it is necessary to constantly strengthen the development of service-oriented manufacturing model, and promote the transformation and upgrading of Chinese

manufacturing. Wu [16] believes that the operation mode of the integrated system of equipment manufacturing and producer services in China is a multifactor coordinated operation mode; furthermore, it puts forward the multifactor cooperation-oriented operation mode of "equipment manufacturing enterprise—market—government." Zeng [17] based on the background of "Internet +" and Industry 4.0, through the empirical research on the industrial integration degree of China's equipment manufacturing industry and its branches and high-tech service industry, furthermore, a new model of network manufacturing in equipment manufacturing industry is proposed. Generally speaking, although the research contents and fields of these two industrial integration models are becoming more and more extensive, they are all centered on "manufacturing service."

Based on substantial numbers of literature amount in China and other countries, many valuable achievements have been made in the study of industrial convergence and the integration of equipment manufacturing and production services, and this has provided the enormous help to this article's follow-up research. However, at present, the level of integration of China's equipment manufacturing industry and production service industry is still at the initial stage of development compared to other countries, and domestic scholars still mainly focus on the national level or the more developed cities and regions, while in the central transition provinces such as Shanxi, the integration of the two industries is still relatively slow. In addition, some empirical research studies are still at the level of a few years ago, the selection of relevant data is also relatively slow, which is now fast-growing China, and the reference is declining. To this end, it is necessary to use more recent data to study current developments and to supplement relevant research on the convergence of the two industries.

Thus, this paper intends to use the input-output method to calculate the overall integration degree of equipment manufacturing and production services in Shanxi Province, with the latest input-output table data, and find closer to the level of industrial integration in Shanxi Province, the impact of factors for empirical analysis, and finally for reference to Shanxi countermeasures.

3. Analysis on the Integration Level of Equipment Manufacturing Industry and Producer Service Industry in Shanxi Province

3.1. Selection of Measurement Methods for Industrial Convergence. According to the research results of related scholars and the actual research situation of this paper, the authors believe that the input-output method can explore the source and direction of input and output among industries and facilitate the study of the links between industrial sectors. At the same time, the results of this method can provide an important reference for economic analysis and policy research in Shanxi Province. Therefore, this article first chooses the input-output method to study the Shanxi Province equipment manufacturing industry and the production service industry fusion level's present situation.

3.2. Index Selection and Data Sources of Industrial Convergence Measurement. The input-output table was first born in America in the 1930s, but the work of compiling the input-output table in China started a little later into the 1990s. Domestic input-output tables are now typically prepared on a five-year cycle. So far, Shanxi Province's latest published input-output table is for 2017, and the previous three published input-output tables were for 2002, 2007, and 2012. But given that the National Bureau of Statistics of the People's Republic of China began to fine-tune some industry classification standards after 2012, to take full account of the completeness and validity of the data, finally, this paper chooses to use the latest two periods of 2012 and 2017 input-output table data to calculate, so as to explore its equipment manufacturing and production service industry levels of integrated development. In particular, the following indicators will be used in this paper, based on the research of Wu [18]:

(1) Intermediate input rate

The intermediate input rate refers to the ratio of the sum of the other industries' intermediate inputs to the national economy. The formula is as follows:

$$F_j = \frac{\sum_{i=1}^{n} x_{ij}}{\sum_{i=1}^{n} x_{ij} + N_j}, \quad (j = 1, 2, \ldots, n). \tag{1}$$

In the formula, F_j represents the intermediate input rate of other industrial sectors of the national economy to the J industry, and X represents the intermediate input of the I industry to the J industry. $\sum_{i=1}^{n} x_{ij}$ is the sum of the intermediate inputs to the J industry from other industrial sectors in the national economy; N_j is the added value of the J industry; and $\sum_{i=1}^{n} x_{ij} + N_j$ represents the total input of each industrial sector to the J industry in the national economy.

The intermediate input rate reflects the proportion of raw materials purchased from other industrial sectors in the total input of each industrial sector in the productive activities. Here, the total input is represented by the intermediate input value added. Therefore, the higher the intermediate input rate is, the lower the added value is.

(2) Intermediate demand rate

The intermediate demand rate refers to the ratio of the intermediate demand of other industries to the total demand of the industries in the national economy. The formula is as follows:

$$G_i = \frac{\sum_{j=1}^{n} x_{ij}}{\sum_{j=1}^{n} x_{ij} + Y_i}, \quad (i = 1, 2, \ldots, n). \tag{2}$$

In the formula, G_i represents the intermediate demand rate of other industrial sectors of the national economy for the I industry, and x_{ij} represents the intermediate demand of J industry for the I industry.

$\sum_{i=1}^{n} x_{ij}$ represents the sum of the intermediate demands for the I industry by other industrial sectors in the national economy, and Y_i represents the final demand for the I industry. $\sum_{i=1}^{n} x_{ij} + Y_i$ represents the total demand of each industrial sector for the I industry in the national economy.

In general, the intermediate demand rate objectively reflects the proportion of intermediate products in the total products in each industry sector, that is, the quantity served by each industry sector as raw materials. The higher the intermediate demand rate of an industry product, the more productive materials it provides, the rawer material it tends to be, and the higher the degree of integration with other industries.

(3) Degree of industrial convergence

According to the above formula, we can establish the model of industry convergence degree. Based on the research results of Wang [19], this paper uses the intermediate demand rate and intermediate input rate to construct the integration model of equipment manufacturing industry and producer service industry as follows:

$$C_i = \frac{1}{2}\left(\frac{1}{2}\left(F_{i\longrightarrow j} + F_{j\longrightarrow i}\right) + \frac{1}{2}\left(G_{i\longrightarrow j} + G_{j\longrightarrow i}\right)\right). \quad (3)$$

In the formula, C_i represents the level of integration between the two industries; $G_{i\longrightarrow j}$ represents the intermediate demand rate of industry I for industry J; and $G_{j\longrightarrow i}$ represents the intermediate demand rate of industry J for industry I. $F_{i\longrightarrow j}$ represents the intermediate input rate of I to industry j; $F_{j\longrightarrow i}$ represents the intermediate input rate of industry J to industry I.

In addition, the value range of C_i is between 0 and 1, but the closer the value of C_i is to 1, the higher the degree of integration between the two industries, and the better the situation of integration; otherwise, the lower the degree of integration, the worse the situation of integration. When the value of C_i is close to 1, it means that the two industries are completely integrated to form a new industry. In order to compare and identify the characteristic level of the degree of industrial convergence, this paper divides the degree of industrial convergence according to the degree of industrial convergence and makes the evaluation table of the degree of industrial convergence, as shown in Table 1.

3.3. Empirical Analysis of Industrial Convergence Measurement. Based on the national economic industrial classification (GB/T4754-2017) and according to the latest statistical classification of production services (2019), this paper reasonably divides and selects equipment manufacturing industry and production service industry. Then, combined with the actual development of equipment manufacturing industry and producer service industry in Shanxi Province, seven subsectors of producer service industry and seven subsectors of equipment manufacturing industry are selected as the research object. Among them, production services specifically include the following: wholesale and retail; transportation, warehousing, and postal services; information transmission, software, and information technology services; finance; real estate; leasing and business services; and scientific research and technology services. The equipment manufacturing industry specifically includes the following: metal product manufacturing, general equipment manufacturing, special equipment manufacturing, transportation equipment manufacturing, electrical machinery and equipment manufacturing, communication equipment, computer and other electronic equipment manufacturing, and instrumentation manufacturing. The following paper will further measure and analyze the overall level of integration between equipment manufacturing and production services in Shanxi Province:

Table 1: Industrial integration rating scale.

Degree of industrial convergence	Level of industrial convergence
$0.8 < C \leq 1.0$	High fusion
$0.7 < C \leq 0.8$	Basic fusion
$0.5 < C \leq 0.7$	Moderate fusion
$0.3 < C \leq 0.5$	Partial fusion
$0 < C \leq 0.3$	It has not fused yet

Based on the input-output data of Shanxi Province in 2012 and 2017, the integration degree of equipment manufacturing and production services can be calculated (Table 2).

From the perspective of input, the intermediate input rates of equipment manufacturing industry in Shanxi Province in 2012 and 2017 were 0.5864 and 0.5493, respectively, while the corresponding intermediate input rates of production services in the same years were 0.3337 and 0.4141, respectively. It is not difficult to find that the input rate of the equipment manufacturing industry in Shanxi Province in these two years is greater than the input rate of the production service industry in the corresponding years, it shows that the development input of equipment manufacturing industry in Shanxi Province in recent years plays a leading role in the development of production service industry in Shanxi Province, and its driving capacity is far greater than that of production service industry. In addition, this is also verified from the side that the production service industry has a very high added value. From the vertical time point of view, the input rate of the equipment manufacturing industry in Shanxi Province in 2017 is less than that in 2012, which shows that the local equipment manufacturing industry has got a qualitative leap and upgraded under the constant attention and hard development of Shanxi Province, and the added value of the industry is constantly rising. Although the input rate of production services in Shanxi Province has slightly increased, it can show that the driving capacity of this industry to the equipment manufacturing industry in Shanxi Province has significantly increased.

Table 2: 2012 and 2017 integration of equipment manufacturing industry and production service industry in Shanxi Province.

Year	Intermediate input rate of equipment manufacturing industry	Intermediate input rate of production service industry	Intermediate demand rate of equipment manufacturing industry	Intermediate demand rate of production service industry	Degree of fusion
2012	0.5864	0.3337	0.1891	0.2993	0.3521
2017	0.5493	0.4141	0.1876	0.4159	0.3917

Note. The above data are calculated by the author himself.

In terms of consumption, the intermediate demand rate of production services in Shanxi Province increased from 0.2993 to 0.4159 in 2012 and 2017. It is obvious that the equipment manufacturing industry's intermediate demand for production services is on the rise, and it is shown that with the accelerating transformation and upgrading of equipment manufacturing industry in Shanxi Province, the production service industry is integrating into the production and development of equipment manufacturing industry, and further deepening the dependence of equipment manufacturing industry on producer service industry. In addition, the demand rate for production services in both years was higher than the demand rate for equipment manufacturing in the corresponding years, indicating that the production service sector is also mainly dependent on intermediate consumption in equipment manufacturing, and the equipment manufacturing industry plays a significant role in its pull. In addition, by contrast, the change in the intermediate demand rate of equipment manufacturing industry is relatively stable and not very volatile.

Finally, according to the calculated fusion degree, the fusion degrees of equipment manufacturing industry and producer service industry in 2012 and 2017 are 0.3521 and 0.3917, respectively. Compared with the evaluation table of industrial integration grade, it can be found that in these two years, the equipment manufacturing industry and producer service industry in Shanxi Province are in a state of partial integration, and the degree of industry convergence in 2017 is higher than that in 2012, which indicates the degree of integration of these two industries is deepening.

All in all, in recent years, with the unremitting efforts of Shanxi Province, the integration trend of local equipment manufacturing industry and producer service industry has been strengthening, gradually moving toward medium integration, and the overall development of the two industries is getting better and better.

4. An Empirical Analysis of the Factors Influencing the Integration of Equipment Manufacturing and Production Services in Shanxi Province

After measuring and analyzing the integration level of equipment manufacturing industry and production service industry in Shanxi Province, this paper will further explore the main factors that affect the integration development of these two industries. On this basis, we select the evaluation index of each influencing factor and build the model of the influencing factor of industrial convergence. Finally, we use the principal component regression analysis to make an empirical analysis, in order to explore the real impact of the two industries in Shanxi factors.

4.1. Establishment of Evaluation Index System of Influencing Factors

4.1.1. Analysis of Influencing Factors and Selection of Indicators. Based on the domestic and foreign scholars' research on the influence factors of industrial convergence, we can know that the convergence level of the two industries is often caused by many factors. Therefore, after fully considering the availability and interpretability of data, and combining the theoretical research of relevant scholars and the actual development of regional industries, this paper sums up the factors affecting the level of integration of the two industries in Shanxi Province, and there are three dimensions: fusion basic dimension, fusion condition dimension, and fusion environment dimension. Among them, the basic dimensions of integration include R&D investment, talent reserve, and technological innovation; the dimensions of integration conditions include market demand, industrial upgrading, and industrial competition, and the dimension of fusion environment includes economic environment, investment environment, and policy environment.

(1) R&D investment: as an important index to measure the development of enterprises, R&D investment is not only an important source for equipment manufacturing enterprises to enhance their competitiveness but also a source of profits for production service enterprises to pursue. In addition, R&D investment needs the enough R&D funds to support, which is one of the key factors for the integration of the two industries, but also an important guarantee for production and operation, technological innovation, and other related activities. Especially for the internal R&D departments of equipment manufacturing enterprises and high-tech R&D enterprises in the production service industry, in the process optimization, product innovation, service quality improvement, and so on, there is no doubt that there is the need for adequate R&D funds as an important support for the sustainable development of their enterprises. Based on this, this paper chooses R&D investment intensity to measure R&D investment degree. In addition, since the investment of R&D funds in a specific region is often relatively limited, the proportion of R&D funds allocated is also relatively stable;

considering the difficulty of obtaining data on R&D funds in specific industries, therefore, this paper selects the total expenditure of R&D funds of Shanxi Province to calculate; and the specific formula is as follows: R&D funds expenditure/GDP total value.

(2) Talent reserve: the integration and development of any industry cannot be separated from the accumulation and investment of talents. Human resource is not only an important long-term strategic reserve resource for enterprises but also an important soft power for enterprises to move to a higher level of development. In terms of the specific impact on industrial integration, high-quality human resources can indirectly affect the overall development of the industry, and at the same time raise the level of interindustry integration and speed up the process of interindustry integration, finally, to promote the birth of new forms of business and the transformation and upgrading of industrial structure. At present, with the rapid development of equipment manufacturing industry and the continuous deepening of the service level of manufacturing industry, the industry's own human resource reserve has long been unable to meet its development needs; meanwhile, the compound innovative talents with a large amount of knowledge and technology reserve are becoming the important footstone to support the development of science and technology. At this time, with the high-tech enterprises in the producer service industry continuously sending high knowledge and technical talents to the equipment manufacturing sector, they will effectively allocate their talent resources, thus better serving the integration of the two industries. Therefore, the reserve of high-quality talents is one of the important factors affecting the integration of the two industries. Based on this, this paper selects the proportion of R&D personnel to measure the talent reserve factor in Shanxi Province, and the specific formula is as follows: R&D personnel number/year-end employment number.

(3) Technological innovation: technological innovation plays a vital role in promoting the integration of equipment manufacturing and production services, and is an important technical support for the integration of the two industries. Technological innovation with its strong penetration gradually blurred the boundaries between the two industries, and enhanced exchanges and cooperation between the two industries, thus promoting the integration of industries. In addition, technological innovation is also one of the important factors to promote the transformation of technological structure and industrial structure. After technological innovation, it will trigger the adjustment and upgrading of technological structure, and then further trigger the change in industrial structure, and at the same time, technological changes will stimulate the new needs of users. In the face of the new market demand, the equipment manufacturing enterprises will actively develop new products, and then cross-penetrate with the high-tech enterprises in the production service industry to continuously meet the new market demand and expand the market volume ratio, thus creating the broad market demand space for the industrial fusion. Therefore, technological innovation constitutes an important internal thrust to promote the integrated development of equipment manufacturing and production services. As one of the important forms of technological innovation, the number of patent applications can directly reflect the achievements of scientific and technological innovation in a region. Based on this, this paper chooses the patent application volume to measure the factors of technological innovation in Shanxi Province.

(4) Market demand: market demand, as an important factor in the integration of the two industries, is an important impetus to accelerate the development of their integration. With the development of social economy and the improvement of market order, consumers will be stimulated to change from traditional, single, and passive consumption demand to new consumption demand. Under the guidance of the emerging trend of demand, equipment manufacturing enterprises and producer service enterprises began to cooperate actively to deduce new fusion products, thus accelerating market consumption and bringing new market profit space, and finally, further deepen the equipment manufacturing and production service industry integration development trends. Combined with the above analysis, this paper thinks that the proportion of gross output value of secondary and tertiary industries in a region can reflect the market maturity and market demand of the region. The higher the proportion of the total output value of secondary and tertiary industries, the better the market development, the more exploitable the consumer demand, and the greater the potential market demand space. In addition, for the equipment manufacturing industry and production service industry, it is more convenient for the equipment manufacturing industry to obtain the necessary production services, and large production service enterprises can also use this condition to extend the industrial chain; furthermore, it is beneficial to the integration and development of the two industries. Based on this, this paper uses the ratio of the secondary and tertiary industries' gross output value to the regional gross output value to measure the market demand of Shanxi. The specific formula is as follows: gross output value of

secondary and tertiary industries/gross output value of regions.

(5) Industrial upgrading: here, the industrial upgrading is mainly reflected in the upgrading of the industrial structure. The upgrading of industrial structure generally refers to the dynamic process of the gradual evolution of industrial structure from low level to high level, technological innovation and upgrading, optimization of management system, and improvement of product quality and production efficiency are often accompanied by this process. In addition, there is a close relationship between industrial structure upgrading and industrial integration development. In general, most scholars thought that the upgrading of industrial structure was promoted by industrial convergence, that is, industrial convergence existed before further industrial upgrading. However, there is a two-way interaction between industrial upgrading and industrial convergence, that is, industrial convergence promotes industrial structure upgrading, and industrial structure upgrading deepens industrial convergence. As far as the equipment manufacturing industry and production service industry are concerned, in the early stage of their development, the two industries will gradually realize the initial integration in products, technologies, markets, management, and organization through interaction and integration; then, when the overall industrial structure is upgraded, it will, in turn, promote the joint development of the two industries and further deepen the integration of their products and technologies, and simultaneously causes the market and the organization management fusion level to stride over a new step. Based on this, this paper chooses the energy consumption rate of GDP to reflect the factors of industrial upgrading, because this indicator takes into account that Shanxi Province is a typical energy-intensive province, so it will consume a lot of energy in the course of its development; therefore, the energy consumption rate of GDP can better reflect the upgrading of industrial structure in Shanxi Province.

(6) Industrial competition: the intraindustry competition is the micromotivation to promote industrial integration, but also to strengthen cooperation between each other and enhance the overall competitiveness of the industry. At present, both the equipment manufacturing industry and the production service industry are facing huge competition, especially when the domestic industrial policy is constantly adjusted, the market is constantly improved, and the barriers to entry in related subsectors are constantly falling, which led to a variety of enterprises have poured into the industry market and launched a fierce competition. In addition, as China's overall economy continues to grow in size, the consumption potential of the market, and the business and investment environment have been significantly enhanced, and the opening-up efforts have also been significantly increased, this has attracted a variety of foreign investors to join, and a variety of large multinational foreign enterprises have poured into China and further exacerbated the competition in China's industrial market. Under this influence, some local equipment manufacturing industries and production service industries will take the initiative to accelerate the pace of independent innovation through industrial integration and concentration ratio, to further optimize the industrial structure, to realize industrial upgrading, and finally, to expand the competitive advantage. Based on this, this paper selects the number of equipment manufacturing and production service enterprises to measure the industry competition index.

(7) Economic environment: the improvement of the level of economic development in a region can provide a stable and good economic environment for the integration of local industries and speed up the process of interindustry integration. After the reform and opening up, China's economies in various regions have made considerable progress, and the overall economic level of society has significantly improved. In particular, China has entered a new era with a sound socialist market economy system with Chinese characteristics, and it is also an important support and guarantee for the integrated development of the industry. In addition, a region's economic development level can also reflect the local human, capital, technology, and other production input factors of the basic stock, related infrastructure conditions, and potential market demand scale. Combining relevant studies at home and abroad and examples of regional economic development, it is not difficult to find that most industries in economically developed regions have sufficient input of production factors, convenient infrastructure conditions, and huge market consumption demand, and as a result, the possibility of industrial convergence and the overall level of convergence are also higher than other backward areas. As for the equipment manufacturing industry and producer service industry, which are highly concentrated production factors, a good economic development environment can expand their industrial scale, enhance production efficiency, and deepen the level of integration. Based on this, this paper chooses per capita GDP to measure the economic and environmental factors in Shanxi Province.

(8) Investment environment: the quality of the regional investment environment often directly affects the enthusiasm of investors and the absorptive capacity of investors, and it is also an important external

environmental factor that affects and restricts the development of regional industry. American scholar Stobaugh [20], in how to analyze the climate of foreign investment, divided the contents of the investment environment into eight factors, including foreign investment factors. This paper argues that foreign investment in China will often be invested in the region of the overall investment environment is extremely careful study and evaluation, and will ultimately make investment decisions. Therefore, foreign investment can indirectly reflect the advantages and disadvantages of a regional investment environment to a certain extent. In addition, the integrated development of equipment manufacturing and production services also needs the support of a good investment environment and external investors. Foreign investment can bring its international management model, sufficient capital, and advanced technology into the development of the two local industries, speed up the integration process of the two industries, and improve the integration quality of the industries, to boost the local economy. In addition, under the new situation, the state has also continuously advocated that local governments should actively face the new situation of foreign investment changes, while appropriately lowering the threshold of foreign investment and expanding the scope of foreign investment under the premise of guaranteeing the overall economic security of the country, and finally, the environment for foreign investment has been further optimized. Therefore, it is quite reasonable to use foreign investment to measure the overall investment environment of Shanxi Province and to use the ratio of foreign direct investment to GDP to quantify the calculation, and the formula is as follows: foreign direct investment/GDP.

(9) Policy environment: the policy environment is an important external influence factor for the development of industrial interaction and integration. A good policy environment can not only reflect the local government's support for industrial development but also promote the degree of industrial integration. Here, the policy environment mainly embodies in the relaxation of government regulation and the coordination of industrial policy. From the above analysis, the deregulation of government can break down industry entry barriers, reduce market access, and reduce the transaction costs between industries, thus accelerating the process of interindustry integration. The coordination of industrial policy mainly shows that the government actively meets the needs of industrial development, and gives appropriate policy support to the industry by promulgating or amending relevant policies, regulations, and rules; for example, we should strengthen financial subsidies or give preferential tax treatment to key development areas, so as to encourage and support the continuous innovation and development of related industries, and accelerate the industrial upgrading and integration. In addition, from another point of view, the current market operation mechanism in China, the government's intervention and impact on market development are still greater. Therefore, the integration of the development of various industries on the need for government policy support and guidance. Of course, it can be predicted that the new industrial policies will provide support and guidance for the development of industrial integration under the gradual transformation of the current government functions and the deepening of the reform of "supervision and service." Based on this, this paper uses the financial science and technology expenditure as the proportion of the general budget expenditure to measure the policy environment.

4.1.2. Establishment of an Indicator System. After a thorough analysis of the factors affecting the integration of equipment manufacturing and production services in Shanxi Province, this paper is based on the selection principles of scientific, feasible, and representative indicators, and finally, the paper constructs the evaluation index system of influencing factors on the integration of equipment manufacturing and production services in Shanxi Province. In particular, the evaluation index system is divided into three target dimensions: fusion foundation, fusion condition, and fusion environment. Each target dimension is subordinate to three criterion dimensions, altogether nine criterion dimensions, and at the same time, an evaluation index is designed for each criterion dimension, as shown in Table 3.

4.2. Model Building. Based on the abovementioned in-depth analysis of the factors influencing the integration of equipment manufacturing industry and production service industry in Shanxi Province and the establishment of the evaluation index system of the factors influencing the integration degree, below, this article will further construct the Shanxi Province equipment manufacturing industry and the production service industry fusion influence factor theory model, as follows:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \ldots + \beta_8 X_{8t} + \beta_9 X_{9t} + \mu_t. \quad (4)$$

Among them, the Y represents the explanatory variable—the convergence degree of the equipment manufacturing industry and the production service industry in Shanxi Province, and X_1 through X_9 stands for explanatory variable—the R&D investment intensity, the proportion of R&D personnel, patent application volume, the ratio of the secondary and tertiary industries' gross output value to the regional gross output value, the energy consumption rate of GDP, the number of equipment manufacturing and production service enterprises, per

Table 3: Evaluation index system of influencing factors on the integration of equipment manufacturing and production services in Shanxi Province.

Target layer	Criterion layer	Index layer	Method of measurement	Mark	Expected impact
Fusion foundation	R&D investment	R&D investment intensity (%)	R&D fund expenditure/GDP total value	X1	+
	Talents reserve	The proportion of R&D personnel (%)	R&D personnel number/year-end employment number	X2	+
	Technological innovation	Patent application volume (piece)	From the Statistical Bulletin of Shanxi National Economy and Social Development	X3	+
Fusion condition	Market demand	The ratio of the secondary and tertiary industries' gross output value to the regional gross output value (%)	Gross output value of secondary and tertiary industries/gross output value of regions	X4	+
	Industrial upgrading	The energy consumption rate of GDP (%)	Directly from Shanxi Statistical Yearbook	X5	−
	Industrial competition	The number of equipment manufacturing and production service enterprises (One)	Directly from Shanxi Statistical Yearbook	X6	+
Fusion environment	Economic environment	Per capita GDP (yuan)	Directly from Shanxi Statistical Yearbook	X7	+
	Investment environment	The ratio of foreign direct investment to GDP (%)	Foreign direct investment/GDP	X8	+
	Policy environment	The financial science and technology expenditure as the proportion of the general budget expenditure (%)	From Shanxi Province Science and Technology Funds Investment Statistical Bulletin directly obtained	X9	+

Note. "+" indicates a positive influence.

capita GDP, the ratio of foreign direct investment to GDP, and the financial science and technology expenditure as the proportion of the general budget expenditure. The t represents the year from 2009 to mid-2019, β_0 represents a constant term, β_1 to β_9 represents the regression coefficient of the explanatory variable, in turn, and μ_t represents a random perturbation term.

4.3. Sources of Data and Methodology

4.3.1. Establishment of an Indicator System. This paper takes the equipment manufacturing industry and producer service industry of Shanxi Province as the research object, and selects the related data of Shanxi Province from 2009 to 2019, in order to make an in-depth analysis on the influencing factors of the convergence of these two industries, most of the original data for the fusion of the measurement of influencing factors come directly from the "China Statistical Yearbook," "China Science and Technology Statistical Yearbook," and "Shanxi Statistical Yearbook," and the official website of Shanxi Provincial Bureau of Statistics issued by the past years, "Shanxi Province national economy and Social Development Bulletin," and "Shanxi Province Science and Technology Funds Investment Statistical Bulletin," and the remaining data by the author consulted the information collated. It should also be noted that data for 2019 and prior years are currently available only owing to the slow production of the relevant statistical yearbooks and the delay in their release dates, considering the timeliness and availability of the data.

In addition, this paper takes the degree of integration between equipment manufacturing and production services in Shanxi Province as the explanatory variable, and on the choice of its data, this paper takes full account of the fact that the input-output method used in the preliminary analysis of the fusion level has no data continuity; that is, only the latest two-stage input-output table can be used to calculate the fusion data in 2012 and 2017; therefore, this paper adopts Wu [18] the measurement method and adopts the coordination degree model to calculate the coupling degree between the equipment manufacturing industry and the producer service industry in Shanxi Province, thus approximately replacing its industrial integration degree, based on this analysis of the relevant factors and industrial integration of the relationship and impact. At the same time, the order parameter model of the model is further constructed as follows:

$$u_j\left(e_{ji}\right) = \frac{e_{ji} - \alpha_{ji}}{\beta_{ji} - \alpha_{ji}}. \tag{5}$$

In the formula, α_{ji} and β_{ji} represent the maximum and minimum of the order variable, respectively, the j represents the region, and the i represents the specific year. In addition, both equipment manufacturing and production services consist of 11 time-series variables, and then, u_1 and u_2 are calculated using a simple weighted average formula, and their coupling is further defined by the following formula:

$$C = \frac{2u_1u_2}{u_1 + u_2}. \tag{6}$$

The integration of equipment manufacturing and production services in 2009–2019 is further calculated by combining formula (6), as shown in the following Table 4.

Table 4: 2009–2019 integration of equipment manufacturing and production services in Shanxi Province.

Year	Degree of fusion
2009	0.2314
2010	0.2448
2011	0.2612
2012	0.2549
2013	0.2696
2014	0.2734
2015	0.2956
2016	0.2997
2017	0.3251
2018	0.3441
2019	0.3654

Data source: it is calculated and collated.

4.3.2. Selection of Research Methods. Through the above analysis, we can find that there are many factors affecting the integration of equipment manufacturing and production services in Shanxi Province. If these variables are brought into the model for simple regression analysis, the multicollinearity between variables will easily appear, thus making the analysis meaningless. In view of this, in order to overcome this problem as far as possible, this paper chooses to use the principal component analysis method to extract several important principal component factors from the nine influencing factors of the convergence degree of these two industries; then, this paper makes a quantitative analysis on the influence level of each principal component factor on the degree of industrial integration, and finally finds out the factors that really affect the integration of equipment manufacturing and production services in Shanxi Province through regression analysis.

4.4. Empirical Process Analysis. In this paper, the related variable indexes and their data were compiled by Excel and entered into SPSS20.0. The new standardized data variables ZY and Xi ($i = 1, 2, \ldots, 9$) can be obtained after the data are standardized. Then, the principal component analysis will be carried out in this paper. But before the analysis, we need to check the variables and sample data to determine whether it is suitable for the one-step principal component analysis. Therefore, the KMO and Bartlett sphericity tests are used to verify whether the following principal component analysis can be performed, and the results are shown in Table 5.

In general, KMO measures the partial correlation between variables, with values ranging from 0 to 1. The principal component analysis is generally not recommended if the KMO value is below the threshold of 0.5. As can be seen from Table 5, the KMO value between variables is 0.368, slightly less than 0.5. At this point, the Bartlett sphericity test needs to be taken into account. The approximate chi-square value is 101.167, the degree of freedom is 36, and the significance level is $\text{Sig.} = 0.000 < 0.05$, indicating that the variables are not independent, but have some significant correlation. Therefore, based on the results of KMO and Bartlett's tests, it is suggested that these sample variables can be used for the principal component analysis.

Table 5: KMO and Bartlett's tests.

Kaiser–Meyer–Olkin measurement of sampling adequacy		0.368
Bartlett's sphericity tests	Approximate chi-square	101.167
	Degree of freedom DF	36
	Sig.	0.000

Furthermore, from the matrix of correlation coefficient of main variables automatically drawn by SPSS20.0 software, we can find that there are higher correlation coefficients among some variables, showing some significant correlation, so we can continue to extract common factors, and the results are shown in Table 6.

The following is a further analysis of the common factor variance table. Table 7 shows that under the principal component analysis method, the original 9 variables can be preliminarily extracted corresponding to the 9 characteristic roots; that is, the variance of the original variables can be explained, and each variable has a common degree of 1. Then, looking at the common degree of the variables after extracting the feature root, we can find that the common degree of each variable begins to appear different. Generally speaking, the larger the common degree value after extraction, the better the variable can be expressed by the common factor. In general, the value greater than 0.7 is enough to show that the variable can be reasonably expressed by the common factor. Comparing with the common degree of variables extracted from Table 7, we can find that the total value of each variable is more than 0.8, which indicates that more than 80% of the information of the original variable can be well interpreted and expressed by the principal component, and the information of the original variable is less lost.

Next, the principal component analysis is needed to extract the main common components. In general, the principal component can be synthetically extracted by two methods, one is by observing whether the characteristic root of the common component is more than 1, the other is by observing whether the cumulative variance contribution of the common component is more than 85%, and after considering the results of the two methods, the principal components can be extracted. In particular, the total variance explained in Table 8 shows that the characteristic roots of the first three principal components are all greater than 1, 4.488, 2.275, and 1.331, respectively. The variance contribution rates were 49.867%, 25.277%, and 14.785%, respectively. The cumulative variance contribution rates were 49.867%, 75.144%, and 89.929%, respectively. From this synthesis, the first three principal components can reflect the original 9 variables to 89.929% of the information, basically covering all the sample size of the original data information.

Further to the principal component analysis of the lithotripsy in Figure 1, we can find that the characteristic values of the first three principal components are relatively large. Among them, the first principal component has the largest contribution to the interpretation of the original variables, followed by the second and third principal components. In addition, from the 4th and later principal

Table 6: Correlation coefficient matrix table of principal component analysis variables.

	ZX1	ZX2	ZX3	ZX4	ZX5	ZX6	ZX7	ZX8	ZX9
ZX1	1.000	0.189	0.145	−0.279	−0.102	−0.280	0.110	0.413	0.694
ZX2	0.189	1.000	0.180	0.444	−0.399	0.061	0.256	−0.485	0.239
ZX3	0.145	0.180	1.000	0.789	−0.846	0.842	0.957	0.013	0.273
ZX4	−0.279	0.444	0.789	1.000	−0.812	0.804	0.844	−0.280	0.064
ZX5	−0.102	−0.399	−0.846	−0.812	1.000	−0.640	−0.884	−0.067	−0.307
ZX6	−0.280	0.061	0.842	0.804	−0.640	1.000	0.796	−0.281	0.030
ZX7	0.110	0.256	0.957	0.844	−0.884	0.796	1.000	0.092	0.410
ZX8	0.413	−0.485	0.013	−0.280	−0.067	−0.281	0.092	1.000	0.494
ZX9	0.694	0.239	0.273	0.064	−0.307	0.030	0.410	0.494	1.000

Table 7: Common factor variance.

	Initial	Extraction
ZX1 (R&D investment intensity)	1.000	0.839
ZX2 (the proportion of R&D personnel)	1.000	0.964
ZX3 (patent application volume)	1.000	0.932
ZX4 (the ratio of the secondary and tertiary industries' gross output value to the regional gross output value)	1.000	0.930
ZX5 (the energy consumption rate of GDP)	1.000	0.852
ZX6 (the number of equipment manufacturing and production service enterprises)	1.000	0.882
ZX7 (per capita GDP)	1.000	0.982
ZX8 (the ratio of foreign direct investment to GDP)	1.000	0.883
ZX9 (the financial science and technology expenditure as the proportion of the general budget expenditure)	1.000	0.829

Table 8: Total variance as explained.

Ingredients	Initial eigenvalue			Extract square sum load		
	Total	Variogram %	Accumulation %	Total	Variogram %	Accumulation %
1	4.488	49.867	49.867	4.488	49.867	49.867
2	2.275	25.277	75.144	2.275	25.277	75.144
3	1.331	14.785	89.929	1.331	14.785	89.929
4	0.444	4.938	94.867			
5	0.328	3.643	98.510			
6	0.083	0.920	99.430			
7	0.027	0.303	99.733			
8	0.023	0.259	99.992			
9	0.001	0.008	100.000			

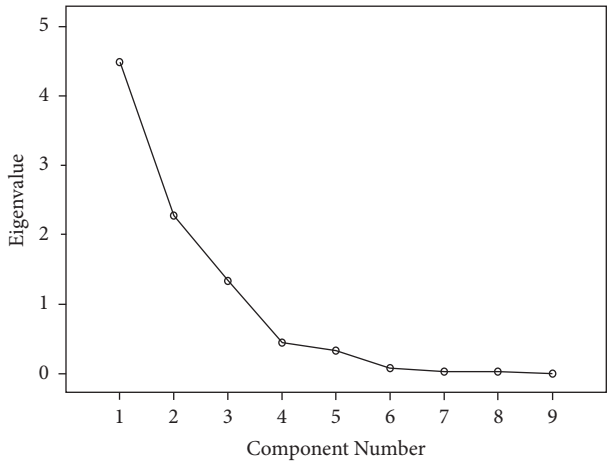

Figure 1: Macadam map.

component eigenvalues less than 1, the contribution to the interpretation of the original variable is gradually weakened.

Based on the above analysis, three principal components can be extracted.

https://fanyi.so.com/javascript; After obtaining the three principal components, the following three principal component score expressions can be derived from the values in the matrix of principal component scores in Table 9:

Table 9: Principal component score coefficient matrix.

	Principal component		
	*F*1	*F*2	*F*3
ZX1 (R&D investment intensity)	0.026	0.865	0.301
ZX2 (the proportion of R&D personnel)	0.393	−0.044	0.899
ZX3 (patent application volume)	0.945	0.089	−0.178
ZX4 (the ratio of the secondary and tertiary industries' gross output value to the regional gross output value)	0.918	−0.293	0.045
ZX5 (the energy consumption rate of GDP)	−0.915	−0.122	−0.014
ZX6 (the number of equipment manufacturing and production service enterprises)	0.845	−0.310	−0.268
ZX7 (per capita GDP)	0.970	0.154	−0.135
ZX8 (the ratio of foreign direct investment to GDP)	−0.103	0.772	−0.526
ZX9 (the financial science and technology expenditure as the proportion of the general budget expenditure)	0.310	0.837	0.179

Table 10: Model fit.

Model	*R*	R^2	Adjusted R^2	Standard estimate error
1	0.933	0.870	0.814	0.43077234

Table 11: Results of multiple regression analysis.

Model		Sum of squares	df	*F*	Sig.
1	Regress	8.701	3	15.630	0.002
	Residual error	1.299	7		
	Total	10.000	10		

$$
\begin{aligned}
F1 &= 0.026ZX1 + 0.393ZX2 + 0.945ZX3,\\
F2 &= 0865ZX1 - 0.044ZX2 + 0.089ZX3 - 0.122ZX5\\
&\quad - 0.310ZX6 + 0.154ZX7 - 0.772ZX8 + 0.837ZX9\\
&\quad + 0.918Z4 - 0.915ZX5 + 0.845ZX6 + 0.970ZX7\\
&\quad - 0.103ZX8 + 0.310ZX9,\\
F3 &= 0.301ZX1 + 0.899ZX2 - 0.178ZX3 - 0.045ZX4\\
&\quad - 0.014ZX5 + 0.268ZX6 -\\
&\quad 0.0135ZX7 - 0.526ZX8 + 0.179ZX9,
\end{aligned}
\tag{7}
$$

where F1, F2, and F3 in the three formulas represent the specific scores of the principal components, respectively, and the ZX1 to ZX9 are the normalized variables corresponding to the X1 to X9.

Using ZY as a dependent variable and *F*1, *F*2, and *F*3 as independent variables, a regression model is established, which is as follows:

$$ZY_t = \alpha_1 F_1 + \alpha_2 F_2 + \alpha_3 F_3 + \mu_t. \tag{8}$$

In the formula, α_1, α_2, and α_3 are regression coefficients, μ_t is a random error, and t represents a year from 2009 to 2019. https://fanyi.so.com/javascript:;

Furthermore, using SPSS20.0 software to test the estimated model parameters, the specific results are as follows:

Table 10 shows that the R^2 of the regression model is 0.870, and the adjusted R^2 is 0.814, which indicates that the degree of the three principal component variables in the regression model can explain that the dependent variables are 81.4%, reflecting the overall fit of the sample.

From Table 11, the *F* value is 15.630 and the SIG value is 0.002, which shows that the regression equation is significant at the level of 1%.

As can be seen from Table 12, the normalized coefficients of F1, F2, and F3 are 0.980, −0.034, and −0.206, and the *t*-test shows that the model setting has some significance. Further regression model formula (10) can be determined from the principal component variable coefficients, as shown below as follows:

$$ZY_t = 0.980F_1 - 0.034F_2 - 0.206F_3. \tag{9}$$

In order to further express the regression equation in terms of standardized independent variables, the matrix composed of the first three principal component coefficient vectors and the principal component regression coefficient estimator matrix are multiplied to obtain the following:

Table 12: Results of multivariate regression coefficients.

Model		Nonstandard coefficient		Standard coefficient	t	Sig.
		B	Standard error			
1	(Constant quantity)	$-9.044E-008$	0.130		0.000	1.000
	F1	0.218	0.033	0.980	6.584	0.000
	F2	−0.030	0.146	−0.034	−0.206	0.842
	F3	−0.156	0.134	−0.206	−1.165	0.282

Table 13: Impact coefficient table of explanatory variables for industrial convergence.

Explanatory variable	Coefficient of influence	Direction of action
ZX1 (R&D investment intensity)	−0.066	−
ZX2 (the proportion of R&D personnel)	0.201	+
ZX3 (patent application volume)	0.96	+
ZX4 (the ratio of the secondary and tertiary industries' gross output value to the regional gross output value)	0.9	+
ZX5 (the energy consumption rate of GDP)	−0.89	−
ZX6 (the number of equipment manufacturing and production service enterprises)	0.894	+
ZX7 (per capita GDP)	0.973	+
ZX8 (the ratio of foreign direct investment to GDP)	0.183	+
ZX9 (the financial science and technology expenditure as the proportion of the general budget expenditure)	0.238	+

$$\beta_i = \begin{pmatrix} 0.026 & 0.865 & 0.301 \\ 0.393 & -0.044 & 0.899 \\ 0.945 & 0.089 & -0.178 \\ 0.918 & -0.293 & 0.045 \\ -0.915 & -0.122 & -0.014 \\ 0.845 & -0.310 & -0.268 \\ 0.970 & 0.154 & -0.135 \\ 0.103 & 0.772 & -0.526 \\ 0.310 & 0.837 & 0.179 \end{pmatrix} * \begin{pmatrix} 0.980 \\ -0.034 \\ -0.206 \end{pmatrix}. \tag{10}$$

$$= \begin{pmatrix} -0.066 \\ 0.201 \\ 0.960 \\ 0.900 \\ -0.890 \\ 0.894 \\ 0.973 \\ 0.183 \\ 0.238 \end{pmatrix}.$$

From this, the coefficients before the standardized variable can be obtained, and then, the regression equation expressed by the standardized independent variable can be obtained as follows:

$$\begin{aligned} ZY = {} & -0.066ZX1 + 0.201ZX2 + 0.96ZX3 \\ & + 0.9ZX4 - 0.089ZX5, \\ & + 0.894ZX6 + 0.973ZX7 + 0.183ZX8 + 0.238ZX9. \end{aligned} \tag{11}$$

Finally, according to the final regression equation, we can get the influence coefficient and the general action direction of each variable index in the following Table 13:

4.5. Analysis of Empirical Results. Based on the principal component regression analysis above, this paper concludes the regression equation between the standardized degree of industrial convergence and the related impact variables, and Table 13 shows the following results:

(1) Industrial integration basis: according to the regression coefficient of R&D expenditure intensity (ZX1), there is a slight negative correlation between R&D expenditure intensity (ZX1) and industrial integration degree (ZY). For every 1 percentage point increase in ZX1, the degree of industrial convergence (ZY) decreases by 0.066%. This paper suggests that the reason for this phenomenon may be related to the size of the data, so the theoretical inference hypothesis of this indicator has not been fully verified. According to the regression coefficient of the ratio of R&D personnel (ZX2), the ratio of R&D personnel (ZX2) has a positive correlation with the degree of industrial convergence (ZY). When the ratio of R&D personnel (ZX2) increases by 1 percentage point, the degree of industrial convergence (ZY) increases by 0.201%. It shows that the reserve and proportion of high-knowledge talents have a positive effect on promoting the integration of equipment manufacturing and production services. Finally, according to the regression coefficient of the number of patent applications (ZX3), there is a significant positive correlation between the number of patent applications (ZX3) and the degree of industrial convergence (ZY). When the number of

patent applications (ZX3) increases by 1 percentage point, the degree of industrial convergence (ZY) increases by 0.96%. It can be seen that the more patent applications, the stronger the close relationship between the equipment manufacturing industry and the production services industry; the deeper integration of these two industries has a good role in promoting; and at the same time, it also reflects that technological innovation has an important influence on the promotion of industrial convergence.

(2) The conditions of industrial convergence: according to the regression coefficient of the ratio of the gross output value of the secondary industry to the total output value of the region (ZX4), there is a significant positive correlation between the ratio of the gross output value of the secondary industry to the total output value of the region (ZX4) and the degree of industrial convergence (ZY); that is, each increase of 1 percentage point in the ratio of the secondary and tertiary industries to the total regional output (ZX4) will increase the degree of industrial convergence (ZY) by 0.9%. This shows that the better the overall development of the secondary and tertiary industries, and the higher their proportion in the GDP of the region, the more they can reflect the vigorous demand of the local consumer market, and for equipment manufacturing and production services to further integration to provide a huge market demand conditions, and further deepen the two industries of interaction and relevance. From the regression coefficient of the rate of reduction of energy consumption of the gross product (ZX5), we can see that the rate of reduction of energy consumption of the gross product (ZX5) has a significant negative correlation with the degree of industrial convergence (ZY); that is, when the rate of energy consumption of the gross product (ZX5) increases by 1 percentage point, it would reduce industrial integration by 0.89%. This shows that when the GDP energy consumption rate is greatly reduced, the overall industrial efficient energy use will be greatly increased; while indirectly reflecting the progress of energy-saving technology and the upgrading of the overall industrial structure of enterprises, it also provides a good upgrade condition for the deep integration of equipment manufacturing and production services. Finally, according to the regression coefficient of the number of enterprises in equipment manufacturing and production services (ZX6), there is a significant positive correlation between the number of enterprises in equipment manufacturing and production services (ZX6) and the degree of industrial convergence (ZY), namely, each increase in the number of equipment manufacturing and production service enterprises (ZX6) by 1 percentage point will increase the degree of industrial integration (ZY) by 0.894%. This shows that when the number of equipment manufacturing and production service enterprises is growing, the resulting fierce internal competition can effectively promote the integration level of the two industries.

(3) Industrial convergence environment: from the regression coefficient of per capita regional gross product (ZX7), we can see that there is a significant positive correlation between per capita regional gross product (ZX7) and industrial convergence degree (ZY); that is, when per capita regional gross product (ZX7) increases by 1 percentage point, industrial convergence (ZY) will increase by 0.973%. This shows that the higher the level of per capita regional gross domestic product, the greater the market development and consumption potential, which is more conducive to promoting the deep integration of equipment manufacturing and production services, and for its development has provided a good economic development environment and the huge market development space. According to the regression coefficient of the ratio of foreign direct investment to GDP (ZX8), there is a positive correlation between the ratio of foreign direct investment to GDP (ZX8) and the degree of industrial convergence (ZY); that is, every 1 percentage point increase in the foreign direct investment share of GDP (ZX8) is associated with a 0.183 percentage increase in the degree of industrial convergence (ZY). This shows that the increase in the foreign direct investment can promote the deep integration of manufacturing and production services, which further reflects the improvement and optimization of the investment environment that can deepen the level of integration of the two industries. Finally, it can be seen from the regression coefficient of the proportion of local fiscal science and technology expenditure in the local general budget expenditure (ZX9) that there is a positive correlation between the proportion of science and technology expenditure of local finance in local general budget expenditure (ZX9) and industrial convergence degree (ZY); that is, each increase of 1 percentage point in the proportion of local fiscal expenditure on science and technology (ZX9) will increase the degree of industrial convergence (ZY) by 0.238%. It is concluded that the higher the proportion of local fiscal expenditure on science and technology is, the better the integration level of equipment manufacturing and production services is. At the same time, it also reflects that a good regional policy environment can provide strong policy impetus for the development of the two industries and enhance the deep-level integration between industries.

Combined with the above empirical results, we can determine that R&D investment divided by R&D expenditure intensity is not expected to be verified, and other indicators have been verified, basically consistent with the

previous theoretical analysis. It shows that talent reserve, technological innovation, market demand, industrial upgrading, industry competition, economic environment, investment environment, and policy environment are the important factors that affect the integration of equipment manufacturing and production services in Shanxi Province. Therefore, Shanxi Province should continue to make efforts in these areas, formulate appropriate development planning, and vigorously promote the local equipment manufacturing industry and production service deep integration.

5. Conclusions and Enlightenment

The purpose of this paper is to study the level of integration development between equipment manufacturing industry and producer service industry in Shanxi Province and its influencing factors. Therefore, this paper uses the input-output method to calculate and analyze the integration degree of two big industries in Shanxi Province in 2012 and 2017. Finally, on this basis, this paper further uses the principal component regression analysis to empirically analyze the two industrial convergence levels of the main factors and find their ultimate impact factors. Two conclusions can be drawn as follows:

(1) *Measurement part*. In this paper, the input-output method is used to calculate the integration degree of equipment manufacturing industry and producer service industry in Shanxi Province in 2012 and 2017. It is further found that in these two years, the equipment manufacturing industry and the producer service industry of Shanxi Province are in the state of partial integration on the whole, and the degree of industrial integration in 2017 has significantly increased compared with that in 2012; it shows that the integration trend of equipment manufacturing industry and producer service industry is strengthening; the two industries are moving toward medium integration; and the overall development trend is getting better.

(2) *Empirical part*. This paper explores and analyzes the related influencing factors of the integrated development of the equipment manufacturing industry and production service industry in Shanxi Province, and on this basis, selects the evaluation indexes and data of each influencing factor; at the same time, this paper further establishes the influence factor model of industrial convergence and finally uses the principal component regression analysis to carry on the empirical analysis to it. The empirical results show that except R&D investment, which is measured by R&D expenditure intensity, which has not been verified, all other indexes have been verified, which is basically consistent with the previous theoretical analysis. As a result, it can be proved that talent reserve, technological innovation, market demand, industrial upgrading, industry competition, economic environment, investment environment, and policy environment are the important factors that affect the integration of equipment manufacturing and production services in Shanxi Province.

Based on the above analysis, we can find that the two major industrial convergence of the impact of almost every factor are closely related to the government. It can be said that the government is the future to promote the development of equipment manufacturing and production services an important hand and support basis. Therefore, the government departments of Shanxi Province should take on the task of industrial integration and actively play the role of government macroeconomic regulation and control to provide a good policy environment for local equipment manufacturing and production services. In addition, as far as equipment manufacturing and producer services are concerned, the talent factor is an important intellectual foundation to ensure the long-term development and deep integration of the two industries. At present, Shanxi is in an important critical period of transformation and development, and the degree of craving for high-quality R&D, management, innovation, and vocational and technical talents is much greater than ever before. Therefore, the Shanxi provincial government needs to establish a comprehensive talent training, reserve, attraction, and incentive mechanism in order to constantly enhance the human intelligence advantage [21].

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest to report regarding the present study.

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