

# Research on the Coupling Coordination Degree of Manufacturing Innovation Chain, Industry Chain, Capital Chain and Talent Chain in Jilin Province

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**Abstract:** Whether the manufacturing industry can be transformed and upgraded is a key issue in the economic development of Jilin Province. At present, the manufacturing industry in this region still suffers from the problems of low overall development level and insufficient innovation ability. Based on this, our team carried out a study on the coupling and coordination of the "four chains" of innovation chain, industrial chain, capital chain and talent chain. We hope to propose feasible ideas for promoting the healthy development of the industry of manufactures in the region. We also expect to extend the application to other provinces and cities in the Northeast region in the future. It benefits other regions and adds to the construction of a strong manufacturing country.

## 1. Introduction

Manufacturing is the foundation of a strong country. The integration and coordinated development of different chains can help realise a virtuous cycle of resources supporting innovation and innovation promoting development. In the future, this feasible idea can be applied to other provinces and cities in the Northeast region to improve the overall level of local manufacturing. This is conducive to the construction of a strong manufacturing country.

## 2. Survey on the Situation of the Manufacturing Industry in Jilin Province

### 2.1 Problem identification

According to the National Bureau of Statistics (NBS) as of the end of 2022, the manufacturing sector in Jilin Province experienced a decline of 7.7 per cent in terms of industrial value added by sector, while the electricity, heat, gas, and water production and supply sector recorded an increase of 3.0 per cent. In terms of industrial profit classification, the mining industry has turned from loss to profit, while the manufacturing industry has decreased by 16.0 per cent. The statistics show that the manufacturing sector is still suffering from a weak growth base and negative profit growth relative to other industries.

### 2.2 Local Manufacturing Development Research Initiative

Grasp the manufacturing industry in Jilin Province based on literature data. Based on the actual situation, it explores its "four-chain" coupling development mechanism, and constructs an evaluation index system aimed at integrating the innovation chain, industrial chain, capital chain and talent chain. In terms of the innovation chain, the number of scientific researchers, the ratio of scientific research expenditure to GDP, and the number of invention patent applications and authorisations are the key to evaluation. In terms of industrial chain, reasonable industrial strategy, advanced industrial stage and industrial structure service are key. In terms of financial chain, asset-liability ratio, total asset growth rate, quick ratio and cost-expense profit ratio are key. In terms of the talent chain, the number of general institutions of higher education, the number of

graduates, the overall employment rate of non-teacher training graduates and the rate of further studies are key. The above information will be analysed in a comprehensive statistical manner.

### 3. Construction of indicator system, research methods, and data sources

#### 3.1 Construction of index system

Based on data search, scientificity, systematicity, and data availability, we will construct a "four chain" coupling evaluation index system. Reflected in table 1.

Table 1 Evaluation Index System for Industry Chain, Innovation Chain, Capital Chain, and Talent Chain

| Primary indicators | Secondary indicators   | Indicator unit         | weight |
|--------------------|--|------------------------|--------|
| innovation chain   | Number of personnel engaged in scientific and technological research and development | number                 | 0.32   |
|                    | R&D funding investment   | Ten thousand yuan      | 0.37   |
|                    | Number of authorized invention patent applications                                   | piece                  | 0.31   |
| Industry Chain     | rational structure of production   | Dimensionless quantity | 0.25   |
|                    | Advanced industrial structure  | %                      | 0.26   |
|                    | Service oriented industrial structure  | %                      | 0.49   |
| capital chain      | Asset liability ratio  | %                      | 0.28   |
|                    | Total Assets Growth Rate   | %                      | 0.23   |
|                    | quick ratio  | %                      | 0.20   |
|                    | Ratio of Profits to Cost   | %                      | 0.29   |
| talent chain       | Number of ordinary higher education institutions                                     | number                 | 0.28   |
|                    | Number of Graduates  | ten thousand people    | 0.26   |
|                    | Overall employment rate of non teacher education graduates                           | %                      | 0.21   |
|                    | Enrollment rate and employment in Jilin  | ten thousand people    | 0.26   |

The innovation chain is measured by three indicators: the number of personnel engaged in scientific and technological research and development, investment in research and development funds, and the number of authorized invention patent applications. The health and vitality of the industrial chain are evaluated through three dimensions: rationalization of industrial structure, advancement of industrial structure, and service-oriented industrial structure.[1] The upgrading of industrial structure is measured by the ratio of the production value of the tertiary industry to the production value of the secondary industry. At the same time, the degree of service oriented industrial structure is evaluated by the ratio of the output value of the tertiary industry to the total output value. The capital chain is measured by four indicators: asset liability ratio, total asset growth rate, quick ratio and cost expense profit margin. The innovation chain and industry chain are linked to create a capital chain, Mainly solve the financing difficulties of various industrial institutions. The talent chain is measured by four indicators: the number of ordinary higher education institutions, the number of graduates, the overall employment rate of non teacher training graduates, the enrollment rate, and the number of employed people in Jilin.

#### 3.2 Research Methods

##### 3.2.1 Entropy method

Entropy method is an objective weighting method based on information entropy theory, used to measure the degree of dispersion between indicators and determine the importance of each indicator in the overall evaluation. The following are the specific steps:

Due to the inconsistent measurement units of the selected secondary indicators, this article first standardizes the initial data using the following formula:

Positive indicators:

$$x'_{ij} = \left[ \frac{x_{ij} - \min(x_{1j}, x_{2j}, \dots, x_{nj})}{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - \min(x_{1j}, x_{2j}, \dots, x_{nj})} \right] + 0.01 \quad (1)$$

Negative indicator:

$$x'_{ij} = \left[ \frac{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - x_{ij}}{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - \min(x_{1j}, x_{2j}, \dots, x_{nj})} \right] + 0.01 \quad (2)$$

Among them, is the standardized value of the j-th indicator in the i-th city,  $i=1,2,3,\dots, n$ ,  $j=1,2,3,\dots, m$ .

Calculate the proportion of the j-th indicator of the i-th city to the sum of these indicators in all cities in Jilin Province for that year.:

$$p_{ij} = \frac{x'_{ij}}{\sum_{i=1}^n x'_{ij}} \quad (3)$$

Calculate the entropy value of the j-th indicator:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad (4)$$

Calculate the deviation degree of the j-th indicator:

$$d_j = 1 - e_j \quad (5)$$

Calculate the weight of the j-th indicator:

$$w_j = \frac{d_j}{\sum_{i=1}^m d_j} \quad (6)$$

Calculate the comprehensive score for the i-th city.:

$$z_i = w_j \times x'_{ij} \quad (7)$$

### 3.2.2 Coupling coordination model

The weight and comprehensive score of the "four chains" obtained by the entropy method are used to calculate the coupling degree between the "four chains". The formula is as follows:

$$C = \left\{ \frac{f(x) \times g(y) \times h(z) \times k(m)}{[\frac{f(x) + g(y) + h(z) + k(m)}{4}]^4} \right\}^{\frac{1}{4}}$$

Among them, C is the coupling degree of the "four chains", with a value range of [0,1]; F(x) is the comprehensive evaluation index of the industrial chain; G(y) is the comprehensive evaluation index of the innovation chain; H(z) is the comprehensive evaluation index of the funding chain. K (m) is a comprehensive evaluation index for the talent chain. Next, calculate the development level of the 'four chains'.

$$D = \sqrt{C \times T} \quad (8)$$

$$T = \alpha f(x) + \beta g(y) + \gamma h(z) + \varepsilon k(m) \quad (9)$$

In equations (8) and (9), D is the coupled co scheduling of "four chains" and four systems; we take  $\alpha=\beta=\gamma=\varepsilon= 1/4$ . We divide the coupling coordination levels according to Table 2

Table 2 Evaluation criteria for coupling coordination level

| degree    | Rank                 | stage              | degree    | Rank                      | stage            |
|-----------|----------------------|--------------------|-----------|---------------------------|------------------|
| 0.00~0.09 | Extremely imbalanced | low-level          | 0.50~0.59 | Barely coordinating       | running in stage |
| 0.10~0.19 | Severe imbalance     | low-level          | 0.60~0.69 | Primary coordination      | running in stage |
| 0.20~0.29 | Moderate imbalance   | low-level          | 0.70~0.79 | Intermediate coordination | Running in stage |
| 0.30~0.39 | Mild imbalance       | antagonistic stage | 0.80~0.89 | Good coordination         | high-level       |
| 0.40~0.49 | Near Dysfunction     | antagonistic stage | 0.90~1.00 | High quality coordination | high-level       |

### 3.2.3 Grey Relation Analysis

In order to further analyze the specific influencing factors of the interaction among the four systems of manufacturing industry chain, innovation chain, capital chain and talent chain in Jilin Province, gray correlation analysis[2] is introduced to measure the specific steps as follows:

Determine the parent sequence and subsequences, average the data in the sequence, find the absolute difference between the parent sequence and each subsequence, and calculate the maximum and minimum values of the absolute difference.

Calculate the gray correlation coefficient. The formula is as follows:

$$\zeta_{i(k)} = \frac{\min_i \min_k |x_{0(k)} - x_{i(k)}| + \rho \times \max_i \max_k |x_{0(k)} - x_{1(k)}|}{|x_{0(k)} - x_{1(k)}| + \rho \times \max_i \max_k |x_{0(k)} - x_{1(k)}|} \quad (10)$$

$\rho$  is a resolution factor that takes the value (0, 1),  $\rho$  is usually taken to be 0.5.

Calculate the degree of association. The formula is as follows:

$$\gamma_i = \frac{1}{n} \sum_{k=1}^m \zeta_{i(k)} \quad (11)$$

The value of  $\gamma_i$  is in the range of [0, 1], and the closer the value of  $\gamma_i$  is to 1, the stronger the correlation between the system indicators, and in this paper, we will refer to Liang Shuguang[25] for the correlation degree of the division standard, see Table 3.

Table 3 Relevance classification criteria

| relatedness | hierarchy          |
|-------------|--------------------|
| 0           | Unrelated          |
| 0~0.35      | Low association    |
| 0.35~0.65   | Medium correlation |
| 0.65~0.85   | High correlation   |
| 0.85~1.00   | High correlation   |
| 1.00        | Full correlation   |

### 3.3 Data sources

The data used to create the indicator system in this article comes from the 2018-2022 Jilin Province Statistical Yearbook, Jilin Province National Economic and Social Development Statistical Bulletin, as well as the statistical yearbooks of 9 prefecture level cities in Jilin Province.

## 4. Empirical analysis

### 4.1 Coupling co scheduling analysis

#### 4.1.1 Calculation and analysis of comprehensive development level

The growth levels of the cities in Jilin Province are shown in Table 4, Table 5, Table 6 and Table 7.

Table 4 Development level- capital chain

|           | 2018     | 2019     | capital chain |          |          |          |
|-----------|----------|----------|---------------|----------|----------|----------|
|           |          |          | 2020          | 2021     | 2022     | 2023     |
| Changchun | 2.330309 | 2.319322 | 2.058265      | 2.413457 | 2.546553 | 2.303817 |
| Jilin     | 2.503314 | 2.749576 | 2.347936      | 2.408035 | 2.493055 | 2.451313 |
| Siping    | 2.522956 | 2.574716 | 2.267358      | 2.390841 | 2.319091 | 2.232802 |
| Liaoyuan  | 2.546303 | 2.752076 | 2.341051      | 2.406692 | 2.339374 | 2.320588 |
| Tonghua   | 2.468602 | 2.492823 | 2.343581      | 2.404165 | 2.408061 | 2.308106 |
| Baishan   | 2.609433 | 2.717524 | 2.362745      | 2.432706 | 2.566832 | 2.784263 |
| Songyuan  | 2.51633  | 2.683888 | 2.340186      | 2.40574  | 2.334375 | 2.260134 |
| Baicheng  | 2.492825 | 2.616028 | 2.360093      | 2.520972 | 2.549811 | 2.461528 |
| Yanbian   | 2.530925 | 2.4306   | 2.396827      | 2.511771 | 2.506854 | 2.461093 |
| jilin     | 2.502333 | 2.59295  | 2.313116      | 2.432709 | 2.451556 | 2.398183 |

Table 5 Development level- talent chain

|           | 2018     | 2019     | talent chain |          |          |
|-----------|----------|----------|--------------|----------|----------|
|           |          |          | 2020         | 2021     | 2022     |
| Changchun | 0.794901 | 0.842917 | 0.815362     | 0.847347 | 0.828435 |
| Jilin     | 1.240194 | 1.256364 | 1.248279     | 1.210594 | 1.244624 |
| Siping    | 1.289226 | 1.297769 | 1.319009     | 1.268626 | 1.272964 |
| Liaoyuan  | 1.336224 | 1.358652 | 1.372995     | 1.329052 | 1.343121 |
| Tonghua   | 1.384405 | 1.420262 | 1.427434     | 1.440863 | 1.426337 |
| Baishan   | 1.390662 | 1.427434 | 1.419348     | 1.412177 | 1.440589 |
| Songyuan  | 1.300366 | 1.286937 | 1.300366     | 1.313795 | 1.291915 |
| Baicheng  | 1.36289  | 1.384405 | 1.36289      | 1.369148 | 1.376959 |
| Yanbian   | 1.308452 | 1.286937 | 1.300366     | 1.320967 | 1.292738 |
| jilin     | 1.26748  | 1.284631 | 1.285117     | 1.279174 | 1.279742 |

Table 6 Development level- innovation chain

|           | innovation chain |          |          |          |          |          |          |
|-----------|------------------|----------|----------|----------|----------|----------|----------|
|           | 2017             | 2018     | 2019     | 2020     | 2021     | 2022     | 2023     |
| Changchun | 0.362295         | 0.343134 | 0.455721 | 0.493011 | 0.574427 | 0.352299 | 0.330931 |
| Jilin     | 0.948263         | 0.945152 | 0.806323 | 0.826157 | 0.94224  | 0.958705 | 0.954369 |
| Siping    | 0.985259         | 0.996581 | 0.981408 | 0.984185 | 0.997361 | 0.989569 | 1.002767 |
| Liaoyuan  | 1.007848         | 1.007688 | 0.996971 | 0.996197 | 1.005645 | 1.007688 | 1.007584 |
| Tonghua   | 0.937627         | 0.925477 | 0.737348 | 0.788653 | 0.914638 | 0.926452 | 0.911612 |
| Baishan   | 1.001385         | 1.005528 | 0.984525 | 0.991803 | 0.99902  | 0.999811 | 1.004699 |
| Songyuan  | 1.002322         | 1.002815 | 0.992354 | 0.994175 | 0.994674 | 1.001451 | 1.001951 |
| Baicheng  | 0.990047         | 0.99259  | 0.967844 | 0.952039 | 0.980753 | 0.988902 | 0.992061 |
| Yanbian   | 0.96522          | 0.974783 | 0.924658 | 0.920404 | 0.950491 | 0.968932 | 0.980173 |
| jilin     | 0.911141         | 0.910416 | 0.871906 | 0.882958 | 0.928805 | 0.910423 | 0.909572 |

Table 7 development level- Industry Chain

|           | Industry Chain |          |          |          |          |
|-----------|----------------|----------|----------|----------|----------|
|           | 2018           | 2019     | 2020     | 2021     | 2022     |
| Changchun | 1.983078       | 2.457916 | 2.389747 | 2.373961 | 2.130484 |
| Jilin     | 2.332753       | 2.128412 | 2.084849 | 2.095852 | 2.051326 |
| Siping    | 2.033149       | 2.318769 | 2.337484 | 2.333818 | 1.924981 |
| Liaoyuan  | 2.457916       | 2.291572 | 2.199141 | 2.194534 | 2.294441 |
| Tonghua   | 2.151156       | 2.309579 | 2.297024 | 2.203949 | 2.310973 |
| Baishan   | 1.981778       | 2.048607 | 1.921504 | 1.966624 | 2.323185 |
| Songyuan  | 2.09755        | 2.136569 | 2.097384 | 2.082026 | 1.977922 |
| Baicheng  | 1.998927       | 2.406325 | 2.414776 | 2.386176 | 2.106605 |
| Yanbian   | 2.506844       | 2.168393 | 2.11962  | 2.126097 | 2.09931  |
| jilin     | 2.171461       | 2.251794 | 2.206837 | 2.195893 | 2.13547  |

From Table 4,5,6 and 7, it can be observed that the development level of the industrial chain shows a trend of first increasing and then decreasing. The development level of the talent chain also shows a trend of first increasing and then decreasing. The innovation chain fluctuates slightly up and down and tends to stabilize. On the contrary, the capital chain shows a trend of first decreasing, then increasing, and then decreasing again. In addition, the talent chain and innovation chain are

showing a steady development trend.

Based on this result, it can be found that the value-added, turnover, and financing capabilities of the manufacturing capital chain in Jilin Province have undergone significant changes. At the same time, combining the changing trends and development trends of the comprehensive development index. The main reason for this phenomenon is that there are problems with the way the Jilin Provincial Government adjusts its industrial structure.

#### 4.1.2 Calculation and analysis of coupling coordination degree

The Coupling and coordinated development level of various cities in Jilin Province is shown in Table 8

Table 8 Coupling and coordinated development level

| Area      | 2018 | 2019 | 2020 | 2021 | 2022 |
|-----------|------|------|------|------|------|
| Changchun | 0.56 | 0.60 | 0.60 | 0.62 | 0.58 |
| Jilin     | 0.70 | 0.68 | 0.67 | 0.68 | 0.69 |
| Siping    | 0.69 | 0.71 | 0.70 | 0.70 | 0.68 |
| Liaoyuan  | 0.71 | 0.72 | 0.70 | 0.70 | 0.70 |
| Tonghua   | 0.70 | 0.69 | 0.69 | 0.70 | 0.70 |
| Baishan   | 0.70 | 0.71 | 0.69 | 0.70 | 0.72 |
| Songyuan  | 0.70 | 0.70 | 0.69 | 0.69 | 0.68 |
| Baicheng  | 0.70 | 0.72 | 0.70 | 0.71 | 0.70 |
| Yanbian   | 0.71 | 0.69 | 0.69 | 0.69 | 0.69 |

According to Table 8, the coordinated development level of Jilin City, Songyuan City and Yanbian Prefecture shows a small decreasing trend. The main reason for the decline in the data related to Jilin City, Songyuan City and Yanbian Prefecture is the severe impact of COVID-19. The epidemic had a serious impact on the value creation index, resulting in weak value creation. In 2021-2022, the coupling coordination value of Changchun City decreases from 0.62 to 0.58, and the coordination level also decreases from primary coordination to barely coordination. After analysing, we believe that the reasons for this change include (1) Changchun city has a large proportion of heavy industry, and the development of high-tech industry is relatively lagging behind. (2) Excessive reliance on the manufacturing industry. (3) Relatively peaceful market competition. In addition, the relevant values of Siping City, Liaoyuan City, Tonghua City, Baishan City and Baicheng City have not changed much and are generally relatively stable.

#### 4.2 Grey Relation Analysis

Due to the complex relationship between the elements in the four systems of industrial chain, innovation chain, capital chain and talent chain,[3] this paper calculates the correlation degree and average value of each index in the four systems, and screens out the key factors affecting the coordinated development of the ' four chains ' of manufacturing industry in Jilin Province. The results are shown in tables 6 to 8.

Combining the grey correlation and the three tables above, we performed the following analysis: For Table 9: The innovation chain system has a medium degree of correlation with the elements in the other three chains. As can be seen from the average value, the highest correlation is between R&D expenditure and talent chain. There is a close correlation between changes in total assets and the innovation chain system. In the chain system, the investment in R&D expenditure is closely related to it.

Table 9 Matrix of correlation between the innovation chain system and the other three systems

| relatd index | M1       | M2       | M3       | M4       | Z1       | Z2       | Z3       | Z4       | Y1       | Y2       | Y3       |
|--------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Y1           | 0.608067 | 0.609282 | 0.536404 | 0.609863 | 0.563368 | 0.613558 | 0.544132 | 0.594623 | 0.609651 | 0.608562 | 0.567753 |
| Y2           | 0.735064 | 0.735222 | 0.72833  | 0.735295 | 0.73085  | 0.735498 | 0.72868  | 0.733794 | 0.735278 | 0.735174 | 0.731285 |
| Y3           | 0.650783 | 0.657707 | 0.308444 | 0.661149 | 0.396307 | 0.666437 | 0.325822 | 0.573788 | 0.659914 | 0.653125 | 0.426136 |
| average      | 0.664638 | 0.667404 | 0.524393 | 0.668769 | 0.563508 | 0.671831 | 0.532878 | 0.634068 | 0.668281 | 0.66562  | 0.575058 |

Table 10 Matrix of correlation between the talent chain system and the financial and industrial systems

| Related index | Z1       | Z2       | Z3       | Z4       | X1       | X2       | X3       |
|---------------|----------|----------|----------|----------|----------|----------|----------|
| M1            | 0.472945 | 0.677787 | 0.44761  | 0.409334 | 0.455653 | 0.290057 | 0.45363  |
| M2            | 0.519413 | 0.713075 | 0.479093 | 0.444107 | 0.329475 | 0.214076 | 0.505202 |
| M3            | 0.210265 | 0.58016  | 0.092378 | 0.442653 | 0.555823 | 0.548568 | 0.243296 |
| M4            | 0.541529 | 0.706718 | 0.494000 | 0.510152 | 0.316804 | 0.367165 | 0.529887 |
| average       | 0.436038 | 0.669435 | 0.37827  | 0.451562 | 0.414439 | 0.354967 | 0.433004 |

Table 11 Matrix of correlation between financial and industrial chain systems

| related index | X1       | X2       | X3       |
|---------------|----------|----------|----------|
| Z1            | 0.574948 | 0.564123 | 0.115261 |
| Z2            | 0.712901 | 0.622813 | 0.47283  |
| Z3            | 0.561148 | 0.554056 | 0.257939 |
| Z4            | 0.559588 | 0.528024 | 0.30707  |
| average       | 0.602146 | 0.567254 | 0.288275 |

For Table 10: most of the indicators between the three chain systems show a moderate degree of correlation. The correlation between the growth rate of total assets and the talent chain system is high. It is worth mentioning that there is a positive relationship between human capital and economic growth. Further research shows that the improvement of the talent chain system and the growth rate of total assets are mutually reinforcing.

The gray correlation between the important factors of the capital chain system and the industrial chain system is reflected in Table 11, and the conclusion shows that most of the indicators are at the medium correlation level. In addition, the growth rate of total assets has the strongest correlation to the industrial chain, indicating that total assets are in an inseparable relationship with the talent chain and the industrial chain. For the industrial chain system, the correlation between the indicators of rationalization of industrial structure and advanced industrial structure are at the medium level, however, the correlation between the indicator of servicing of industrialized structure and the capital chain is quite low. It can be seen that the four-chain system is still in the process of continuous integration and adjustment.

## 5. Suggestion

In order to improve the level of manufacturing in Jilin Province, we put forward corresponding strategies and suggestions based on the influence and significance of each key factor.

(1) Reduce the regional development gap and find a comprehensive "four-chain" overall development path. In general, we must ensure the comprehensiveness of policy planning, and consider the coordination of the four chains of industry, innovation, capital and talent. We should combine the characteristics of our own region, make timely policy adjustments for the missing links, and ensure the balance of policy release.

(2) Integrate the coupling of industrial chain and innovation chain, create a "fortress" for development, and realise the key connection. Guided by market demand, industrial upgrading and tapping into user demand should be carried out in a two-pronged manner.[5] Take innovation transformation as the basis, improve the innovation implementation ability of each subject in the innovation chain, and tap the competitiveness of the innovation chain.

(3) Improve the structure of capital allocation and stabilise the capital chain. On the one hand, it is necessary to actively encourage the entry of funds to promote innovation and development, and promote the seamless connection of capital and projects. On the other hand, optimise the capital allocation structure and improve the capital utilisation rate.

(4) Comprehensively deepen the reform of institutional mechanisms, based on the local scientific introduction of talents, strong talent chain . Based on the local industrial layout, development planning and other actualities, formulate policies with distinctive local characteristics and usefulness, and improve the talent project and performance evaluation mechanism. Innovative ways

to attract talents, build a talent gathering platform, and continuously improve the talent service process to create a wide range of opportunities and impetus for the growth of talents.[6]

## 6. Conclusion

Based on the data of the past five years, the "four chains" integration development index of different regions is analysed. There is an obvious difference in the level of chain integration and development between the northern and southern parts of the region. The southern region is at a higher level. Specifically, Liaoyuan City has the highest score, followed by Baicheng and Jilin City, and Changchun and Songyuan City have the lowest.

As a strong province for innovation and manufacturing development in China, Jilin needs to deepen reforms to address institutional issues in the integration of the "four chains". This includes focusing on modernising advanced industries and accelerating manufacturing progress. At the same time, it adheres to the principles of high-end, intelligent and service-oriented industries. [4]Give full play to the functions of core areas such as modern automobiles and rail equipment, which have an important role in driving the province's resource allocation, industrial progress and innovative development.

We must improve the policy mechanism for the integration of the "four chains". We need to give full play to the resource and talent advantages of regions that are well integrated, and build a comprehensive industrial system that meets our own requirements for regions that are not well integrated. We can create a complementary, high-quality regional economic pattern and find a path for the development of the "four chains" integration in the province.

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