Research on Resilience Measurement and Impact Effects of China's High tech Manufacturing Industry

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Abstract. This article defines the connotation of resilience in high-tech manufacturing industry, measures the resilience of China's high-tech manufacturing industry from the perspectives of fracture toughness and impact toughness from 1997 to 2022, constructs indicator obstacle and contribution models, identifies the main influencing factors of industrial resilience from both positive and negative aspects, and conducts empirical analysis on the impact effects. Research has found that since 1997, the resilience index of China's high-tech manufacturing industry has shown periodic fluctuations in growth and transformation, specifically divided into four stages: negative growth, low-speed growth, rapid growth, and impact transformation. There is an interactive effect between innovation and transformation as the main factors affecting the resilience of high-tech manufacturing industry and industrial resilience.

Keywords: high-tech manufacturing industry, Industrial resilience, Interactive effect, Industrial innovation, Industrial transformation.

1. Introduction

In recent years, China's manufacturing industry has achieved remarkable achievements that have attracted worldwide attention, but it has also experienced multiple impacts and challenges in the process of development. The Asian financial crisis in 1997, the SARS epidemic in 2003, the global financial crisis in 2008, and the Greek debt crisis in 2009 have brought challenges to the development of China's economy and manufacturing industry. The global COVID-19 epidemic in early 2020 is another test of China's economic resilience. After experiencing several crises and challenges, China's manufacturing industry has not declined, but has shown increasingly strong resilience and industrial resilience in the face of multi-level economic fluctuations.

The 14th Five Year Plan proposes that China must firmly build a strong manufacturing country, and focus on innovation, intelligence, strategy, and green development. In the 14th Five Year Plan, it is mentioned that promoting the development of China's high-tech manufacturing industry requires strengthening innovation drive, increasing R&D investment support, encouraging enterprise innovation, providing tax incentives, subsidies, etc., promoting the integration of industry, academia, research and application, and facilitating the transformation of achievements; We need to strengthen the cultivation of industrial clusters, cultivate strategic emerging industry clusters, guide enterprise agglomeration, strengthen regional cooperation, and promote balanced development of industries in the eastern, central, and western regions; We need to vigorously promote the digital transformation of enterprises, support their digital and intelligent transformation, reward enterprises that adopt new technologies, and develop the intelligent manufacturing equipment industry. However, the development of China's high-tech manufacturing industry is still facing numerous difficulties, with the first and foremost being the limitation of core technologies in related industries. Some key technologies rely on imports, such as high-end chip manufacturing, and there is insufficient motivation for enterprises to invest in independent research and development; Secondly, the ecosystem of high-tech manufacturing industry is not perfect, the upstream and downstream coordination of the industrial chain is not close, the support for productive service industry is insufficient, which increases the cost and innovation difficulty of enterprises; Finally, the development of high-tech manufacturing industry still faces a serious talent shortage problem, with a

shortage and serious loss of high-end compound talents, which restricts the innovation and development of enterprises. Especially during the impact of the COVID-19, China's high-tech industry faced the following two major problems: first, there was a serious shortage of important materials, and production supply was lagging behind; Secondly, the process of globalization has been hindered, and the risk of China's industrial chain being "cut off" has increased. Therefore, China should attach great importance to the development of high-tech industries. Vigorously developing China's high-tech manufacturing industry can not only ensure China's economic security, reduce dependence on key foreign technologies and products, cope with external shocks, and ensure stable economic operation; At the same time, it can enhance the international competitiveness of China's related industries, strengthen resilience, enable enterprises to gain an advantage in international competition, increase product added value and international market share; In addition, it is beneficial for China to promote the upgrading of high-tech industries, help high-tech industries develop towards high-end, intelligent, and green directions, optimize industrial structure, and promote high-quality economic development.

Currently, few scholars have defined and studied the resilience of industries, and the resilience of high-tech manufacturing industries is even rarer. In a few literature related to industrial resilience, larger industrial systems such as industry and manufacturing are often used as research objects, while research objects related to segmented industries mainly include the automotive industry, rail transit industry, etc. On the basis of previous research scholars, this article considers new elements of industrial resilience, takes high-tech manufacturing as the research object, measures the resilience index of China's high-tech manufacturing industry from 1997 to 2022, identifies the main influencing factors through obstacle and contribution models, and conducts impact effect research.

2. Research Design

2.1. Construction of Evaluation Indicator System

The dependent variable of this article is the resilience level of high-tech manufacturing industry, represented by the overall resilience index (RESI). The measurement methods of resilience in the field of economics are mainly divided into single indicator method based on core variables and comprehensive indicator system method based on multiple variables. The single indicator method generally takes changes in GDP or employment as the core variables (Doran and Fingleton, 2018; Han and Goetz, 2019). When studying industrial resilience, a comprehensive indicator method with multiple variables is adopted (Briguglio et al., 2009; Rajesh, 2020). This article refers to the research of Cao De et al. (2020) and divides the factors that affect resilience into two dimensions: internal and external. At the same time, combined with the division of resilience in physics, fracture toughness and impact toughness are used as two primary indicators. Fracture toughness is divided into three secondary indicators: robustness (Zeng Bing and Zhang Yan, 2018; Tang Min et al., 2019; Xiao Zhiwen et al., 2019), liquidity and innovation, and impact toughness is divided into three secondary indicators: guarantee, vulnerability and transformation (Cui Juanjuan and Wang Ying, 2015; Zeng Bing, 2020; He Zhengwen et al., 2019). Chu et al. (2020) established a resilience measurement system for high-tech manufacturing industry, consisting of 6 secondary indicators and 21 tertiary indicators.

The construction of the resilience index system for high-tech manufacturing industry combines the origin of resilience, the connotation of resilience in high-tech manufacturing industry, and the industrial characteristics of high-tech manufacturing industry. Firstly, the concept of fracture toughness in physics, which is independent of the magnitude of external forces, can be regarded as an internal influence; Impact resilience is the ability of high-tech manufacturing industries to resist external shocks, examined from external influences on high-tech manufacturing industries. Fracture toughness takes into account the inherent scale attributes of the industry and the conditional endowments accumulated over history; Impact resilience considers the support and vulnerability risks that the industry can withstand. Secondly, based on the connotation of resilience and high-tech manufacturing resilience, secondary indicators are determined. In terms of fracture toughness,

robustness represents the inherent accumulation scale of high-tech manufacturing industry, liquidity represents the factor endowment of industrial development accumulation, and innovation reflects the driving force of industrial adjustment and long-term development; In terms of impact resilience, the guarantee represents the external support provided to high-tech manufacturing industry, the vulnerability reflects the external risks and obstacles encountered in industrial development, and the transformation considers factors such as the further development of high-tech manufacturing industry towards intelligence, greenness, and market prospects. Finally, based on the nature and characteristics of the high-tech manufacturing industry, while considering the availability of data, the third level indicators are determined. The final system is shown in Table 1.

Table 1. Evaluation Index System for Resilience of High tech Manufacturing Industry

First level indicators	Second level indicators	Third level indicators	Indicator Description	Attribute
Breaking Resilience -BR	Robustness R_1	Total value of high-tech manufacturing industry V_1	Directly obtain statistical yearbook query	Positive
		Total profit of the enterprise V_2	Directly obtain statistical yearbook query	Positive
		Enterprise competitiveness V_3	Enterprise main income/Manufacturing main income	Positive
	Mobility R_2	Capital flow V_4	Internal expenditure of R&D funds/main business income	Positive
		Talent flow V_5	Enterprise R&D personnel	Positive
		Technical flow V_6	Number of research and development institutions	Positive
	Creativity R_3	Innovation personnel investment V_7	Number of R&D personnel/total number of employees in the industry	Positive
		Innovation funding investment V_8	Internal R&D expenditure as a percentage of GDP	Positive
		Innovation output V_9	New product sales revenue/main business revenue	Positive
		R&D capability V_{10}	Number of valid invention patents	Positive
		Government support V_{11}	Government funding	Positive
	Security R_4	Investment amount V_{12}	Directly obtain statistical yearbook query	Positive
		The degree of industrial control V_{13}	Expenditure on purchasing domestic technology funds	Negative
Impact Resilience -IR	Vulnerability R_5	Price risk V_{14}	Industrial Producer Price Index	Negative
		Unemployment risk V_{15}	Unemployment rate	Negative
		Degree of foreign control V_{16}	Foreign direct investment	Negative
		International Competitiveness V_{17}	Total imports and exports	Positive
	Transitional R_6	Inteligent Level V_{18}	The number of patent applications for artificial intelligence	Positive
		Green level V_{19}	Energy consumption per 10000 yuan of GDP	Negative
		Consumption potential V_{20}	Urbanization rate	Positive
		Consumption level V_{21}	Engel coefficient	Negative

2.2. Data sources and preliminary processing

This article takes the resilience of China's high-tech manufacturing industry as the research object, considering the availability and comparability of data, and adopts relevant data of high-tech manufacturing enterprises and industries from 1997 to 2022. The data mainly comes from the "China Statistical Yearbook" and the "China High tech Industry Statistical Yearbook". The earliest statistical yearbook for the high-tech industry was the "China High tech Industry Statistical Yearbook" in 2002, and data from earlier years were supplemented through the "China Science and Technology Statistical Yearbook". The data on the total industrial output value of national high-tech enterprises comes from the "China Torch Statistical Yearbook", and the data on the number of artificial intelligence patent applications comes from the "2022 Artificial Intelligence China Patent Technology Analysis Report". Due to the long time span of the data required for the research, it is difficult to obtain comprehensive data. For example, the indicator of "level of intelligence" is missing data from 1997-1999, and the indicator of "level of greenization" is missing data from 2019 and 2022. Therefore, linear interpolation is used to supplement the missing data for individual years; The indicator data of "government support" is missing from 2009 to 2017, and time series regression analysis is used for fitting; The indicator of "consumption level" was directly obtained from the China Statistical Yearbook from 1997 to 2013, and the data from 2014 to 2022 was calculated using the Engel coefficient formula.

Due to the inconsistent calculation criteria of each indicator and the existence of dimensional differences, dimensionless processing is applied to each indicator. Based on the evaluation index system constructed above, this article collected data on 19 indicators in the above index system from 1997 to 2022, and set the dataset for each indicator as {x * (i, j) | i=1、2,…,24,j=1,2,…,19} , Where x * (i, j) is the jth indicator value of the i-th year before standardization; Use the method of averaging to eliminate the dimensionality of each indicator value:

$$x(x,j)=\frac{x^{*}(i,j)}{\overline{x_j}},\ x^{*}(i,j)\ is\ a\ positive\ indicator \tag{1}$$

$$x(x,j)=\frac{\frac{1}{x^{*}}(i,j)}{\overline{x_j}},x^{*}(i,j)\ is\ a\ negative\ indicator \tag{2}$$

In the process of dimensionless processing, using the mean method has certain advantages. On the one hand, the mean method can effectively preserve the relative size relationship between the original data. After nondimensionalization, the original size order of the data will not change. On the other hand, the mean method is relatively less affected by extreme values. When there are a small number of maximum or minimum values in the dataset, the mean is not excessively affected by extreme values like some other methods such as range normalization. This makes the dimensionless data more stable and can reflect the overall characteristics of the data to a certain extent. When analyzing data with certain fluctuations, it can provide relatively reliable results.

2.3. Research Methods

2.3.1. Indicator weighting method based on the combination of information weight and independence weight

Excluding subjectivity, the entropy method with objective weighting is used to reflect the degree of variation in information between the three levels of indicators, forming information weight; At the same time, the information redundancy between indicators is obtained through the correlation coefficient matrix of each indicator, reflecting the independence of the information content between indicators and forming independence weights. The information content weight and independence weight are multiplied and combined to form the information entropy weight adjusted for independence, which reflects the indicator weight from different aspects.

2.3.2. Indicator synthesis method

The index synthesis methods involved in this article include two types: one is the index synthesis method based on linear weighting; The second is the index synthesis method based on geometric mean, which uses linear weighting to obtain the total toughness index using each three-level index. Using the geometric mean method, the fracture toughness and impact toughness of toughness changes, as well as the contribution of each two-level index, are analyzed. This article mainly analyzes the time evolution characteristics and indicator barriers based on the resilience index results of high-tech manufacturing industry in each year obtained by the indicator linear weighting method, and conducts indicator contribution analysis based on the geometric mean method.

2.4. Model Setting

2.4.1. Obstacle Degree Model

By constructing an obstacle degree model, rank the main obstacle indicators that affect the resilience index of high-tech manufacturing industry at different stages.

$$H_{ip} = \begin{cases} 1 - Y_{ip}, & Y_{ip} \le 1 \\ 0, & Y_{ip} > 1 \end{cases} \tag{3}$$

$$Q_{ip} = \frac{w_p H_{ip}}{\sum_{j=1}^{n} w_p H_{ip}} \times 100\% \tag{4}$$

Among them, Q_{ip} is the obstacle degree of the indicator, and the higher the obstacle degree, the stronger the hindering force of the indicator on enhancing the resilience of high-tech manufacturing industry; Hip is the deviation of the i-th year's p-th indicator Y_{ip} from the average level of resilience, that is, the deviation degree of the indicator; W_P is the corresponding indicator weight. In equations (3) and (4), i=1,2,..., 24. When calculating the obstacle degrees of breaking resilience and impact resilience, p=1,2; when calculating the obstacle degrees of each secondary index, p=1,2,..., 6.

2.4.2. Contribution Model

Explore the contribution of six secondary indicators to breaking resilience and impact resilience, as well as the contribution of breaking resilience and impact resilience to total resilience. Logarithmically process both sides of equation (3) to obtain equation (6), which can reflect the contribution of changes in each secondary indicator to changes in breaking resilience and impact resilience, as well as changes in breaking resilience and impact resilience to changes in total resilience over different time periods.

$$\ln(I_i) = \frac{1}{m} \sum_{p=1}^{m} \ln(Y_{ip}) \tag{5}$$

$$\triangle I_i \approx (\frac{1}{m}) \left[\sum_{p=1}^{m} \left(\frac{\overline{I_i}}{\overline{Y_{ip}}} \right) \triangle Y_{ip} \right] \tag{6}$$

3. Resilience measurement results of high-tech manufacturing industry

The combination weight not only considers the degree of variation between each indicator, but also takes into account the correlation between each indicator. This article analyzes the industry resilience results of the combination weight output after independent adjustment of information entropy weight, as shown in Figure 1. In the preliminary data processing of this article, the normalization method was used for dimensionless processing. Therefore, the resilience index of 1 represents the average level of resilience in high-tech manufacturing industry from 1997 to 2022. The

resilience of high-tech manufacturing industry broke through the average level by a small margin in 2014.

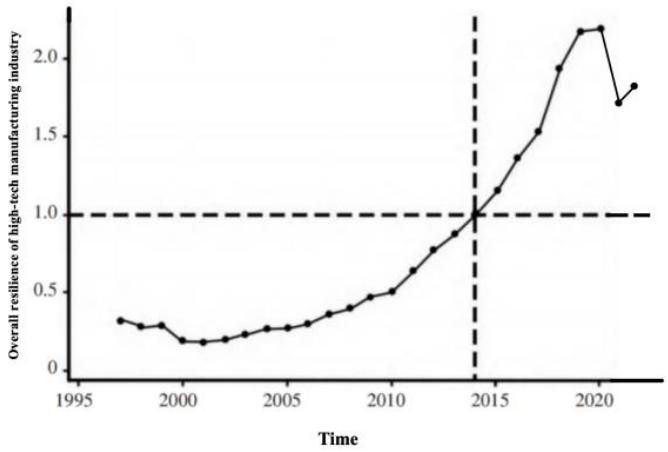

Fig. 1 Measurement results of resilience index for high-tech manufacturing industry from 1997 to 2022

As shown in Figure 2, the resilience index of China's high-tech manufacturing industry showed a phased fluctuation growth and transformation trend from 1997 to 2022. Based on the growth rate of resilience, the resilience level of China's high-tech manufacturing industry from 1997 to 2022 is divided into four major stages.

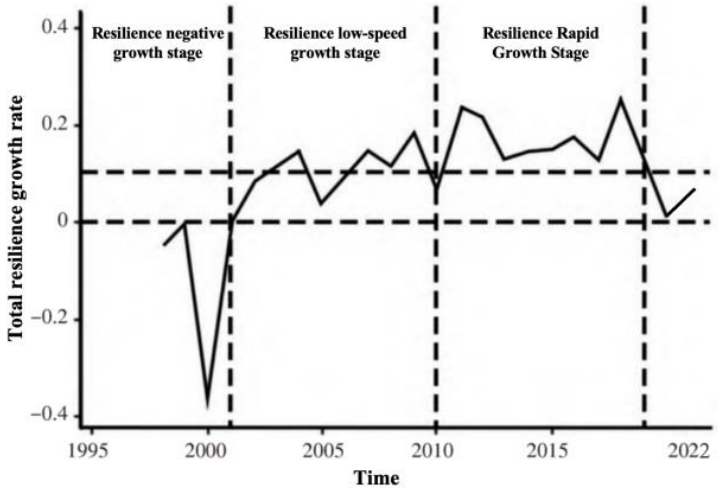

Fig. 2 Growth rate of resilience index of high-tech manufacturing industry from 1997 to 2022

The period from 1997 to 2001 was a stage of negative growth in resilience, during which the resilience index showed a negative growth state. Since 1997, the resilience index has been decreasing year by year, with an average annual growth rate of -9.879%. This indicates that the high-tech manufacturing industry was significantly affected by the 1997 Asian financial crisis; The period from 2002 to 2010 was a period of slow growth in resilience, during which the resilience index did not exceed 1 and the daily growth rate was slow. At the same time, the growth rate fluctuated significantly around 10% during this period, with an average annual growth rate of 11.348%. In 2007, the resilience index increased by 15.299% year-on-year, and in 2008, it increased by 11.454% year-on-year. Due to the impact of the 2008 international financial crisis, the growth rate of resilience index slowed down that year. The Greek debt crisis in December 2009 dealt a heavy blow to China's manufacturing industry, which is mainly exported to Europe. In 2010, the growth rate of resilience index in high-tech manufacturing was only 7.187%; The period from 2012 to 2019 was a period of rapid growth in resilience, during which the resilience index exceeded the average level of 1, with daily growth rates exceeding 10%. Among them, the highest growth rate of resilience level reached 25.867% in 2018. The COVID-19 broke out in 2019, and the overall resilience of high-tech manufacturing industry in

2019-2022 showed a trend of negative growth first and then transformation. Affected by COVID-19, the overall resilience index in 2021 was 25.213% lower than that in 2020, and the general high-tech manufacturing industry was severely impacted. However, with the active adjustment and adaptation of the government, the index increased by 7.361% in 2022, and the industry began to digest the impact trauma, and recover industrial resilience through industrial innovation and adjustment.

4. Analysis of Obstacles and Contributions to the Resilience Index of Three High Tech Manufacturing Industries

The indicator obstacle degree in this article refers to the impact value of each indicator on the resilience of high-tech manufacturing industry, reflecting the obstacle effect of each indicator when the resilience of high-tech manufacturing industry has not reached the average level; The contribution of indicators refers to the impact of changes in various indicators on the resilience of high-tech manufacturing industry, measuring the proportion of resilience changes affected by changes in various indicators. Essentially, it explores the main factors affecting the resilience of high-tech manufacturing industry through both positive and negative aspects.

4.1. Analysis of Index Obstacles

As shown in Figure 3, the hindering effects of breaking resilience and impact resilience on industrial resilience exhibit phased characteristics.

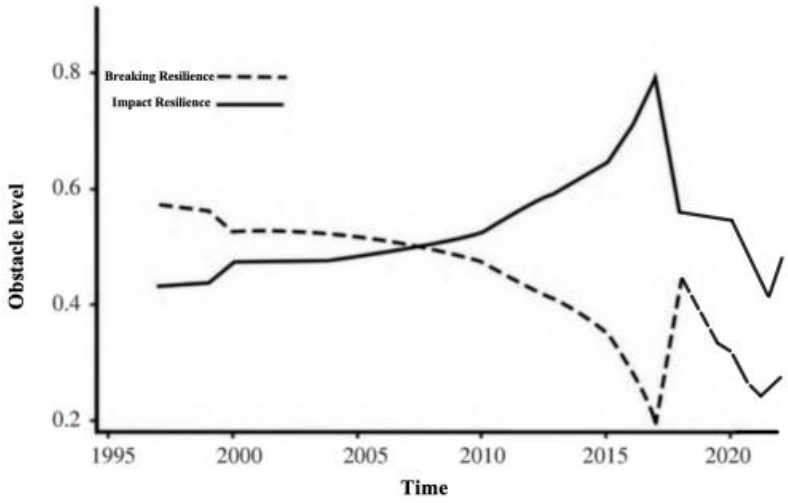

Fig. 3 The impact of Breaking Resilience and Impact Resilience on industrial resilience

The ranking of the hindering effects of fracture toughness and impact toughness on total toughness began to change in 2008. Before 2008, the hindering effect of fracture toughness on total toughness was greater than that of impact toughness. After 2008, impact toughness became the main factor affecting total toughness. From 1997 to 2007, the fracture toughness obstacle degree was greater than the impact toughness obstacle degree, with fracture toughness playing the main obstacle role, indicating that there is still a lot of room for development in the historical scale and accumulated conditions of high-tech manufacturing industry since 1997; From 2008 to 2018, the impact resilience barrier was greater than the fracture resilience barrier, and impact resilience played a major obstacle role in overall resilience. During longer economic cycles, high-tech manufacturing was mainly affected by external support and shocks. The impact of shocks such as the 2003 SARS epidemic, the 2008 international financial crisis, and the 2009 Greek debt crisis on the development of high-tech manufacturing was stronger than the internal impact of the industry itself. Since 2019, the fracture toughness and impact toughness of high-tech manufacturing have both exceeded the average level of 1. At this time, both fracture toughness and impact toughness have a significant impact on the overall toughness, which means that internal and external impacts may limit the development of toughness in high-tech industries. Both types of toughness need to be highly valued.

Before 2010, the impact of robustness, liquidity, and innovation on industrial fracture resilience was relatively stable, and the proportion of obstacles in the three indicators did not show significant fluctuations. After 2010, the proportion of obstacles in the three indicators changed significantly, and the obstacle effect of innovation gradually weakened. The innovation advantage of high-tech manufacturing industry began to gradually emerge. From 1997 to 2019, during the long economic cycle, innovation>liquidity>robustness, and innovation became the main bottleneck for enhancing the resilience of high-tech manufacturing industry. The high-tech industry is an industry with high research and development investment intensity, and technological innovation should be the main advantage that distinguishes high-tech manufacturing from traditional manufacturing. However, this advantage feature has not been highlighted in the long economic cycle, and instead shows the problem of insufficient industrial innovation; From 2019 to 2022, there has been a significant change in the ranking of indicator barriers, with liquidity>robustness>innovation. Under the impact of the COVID-19, the role of innovation has been greatly reduced. Compared with the traditional manufacturing industry, the high-tech manufacturing industry with capital intensive demand has a stronger demand for liquidity.

From 1997 to 2018, in the ranking of obstacles affecting impact resilience indicators, transformational>fragile>protective; In 2019, it was vulnerability>transitional>guarantee, and in 2022 it changed again to transitional>vulnerability>guarantee, with both transitional and fragile obstacles accounting for over 40%. In the context of the COVID-19, the high-tech manufacturing industry has recovered from the broken industrial state and transformed the industrial resilience from a single and static model to a diversified and dynamic higher level industrial resilience. Therefore, the transformability has become the most important obstacle in the industrial resilience.

4.2. Analysis of Indicator Contribution

According to the division of resilience growth rate stages, the contribution of indicators is observed in four stages: 1997-2001, 2002-2010, 2011-2019, and 2019-2022. As shown in Table 2, the influence of changes in fracture toughness on changes in total toughness gradually weakens over time, while the contribution of impact toughness to total toughness gradually increases. The contribution of robustness changes in fracture toughness gradually decreases, while innovative changes have a stronger impact on fracture toughness; The contribution of transitional resilience in impact resilience has changed from negative to positive, and has increased to 51.32% from 2020 to 2022. The contribution rate of protective changes to impact resilience is the highest, while the contribution of vulnerability to changes in impact resilience is the smallest. In terms of contribution rate, vulnerability has the lowest contribution rate, while innovation has the most stable contribution rate, stabilizing at around 40% in each stage.

Based on the actual economic situation, after more than 20 years of development, China's high-tech manufacturing industry has gradually shifted from relying on fracture toughness to relying on impact toughness. This indicates that the inherent basic capabilities of China's high-tech industry have been gradually consolidated, but the resilience recovery ability to external shocks, especially global shocks, still needs to be improved. Specifically speaking of fracture toughness, the robustness of China's high-tech industry has always had a relatively low impact on fracture toughness, which indicates that the scale and influence of relevant high-tech enterprises have not been very strong. Secondly, although the impact of capital liquidity on fracture toughness was relatively low in previous years, it has gradually become a more important factor in recent years when the COVID-19 occurred, which indicates that in the context of the huge global impact, liquidity is the first factor that determines whether related industries or enterprises can survive. The impact of innovation on industrial resilience has always been the most important factor in fracture resilience. This is because China's high-tech manufacturing industry has a short development time and limited accumulation of related industry resources. Relevant industries and enterprises can only offset the negative impact of their lack of industry experience by significantly enhancing their own innovation, continuously expanding and innovating products, markets, and business models.

From the perspective of impact resilience, robustness has always been an important factor affecting impact resilience, fundamentally due to the weak foundation of China's high-tech industry development and the face of internal and external challenges. Supporting the steady development of the industry can ensure that high-tech industries seek a longer-term future. Therefore, relevant governments and industry alliances should propose effective strategies for the current development status of the industry and strictly and efficiently implement them to ensure that the industry has strong risk resistance capabilities when facing external impacts.Secondly, the impact of industrial vulnerability on impact resilience has always been weak. This is because although the development of China's high-tech industry is still constrained by core technologies, it is able to isolate external influences in terms of local employment, price setting, and foreign control. Finally, transformation becomes more and more important when external shocks are coming. Especially when the COVID-19 is coming, if the industry cannot rely on the help of policies or industries to survive on its own robustness, then active industrial transformation will be the most effective tool for China's high-tech manufacturing industry to open up a new future. The government and industrial policies should not only provide support related to high-tech manufacturing policies or funding, but also actively guide related industries and enterprises to have flexible management and risk diversification awareness in their operations. When external shocks strike, they can successfully transform by diversifying their own production and operation, thereby reducing risks and costs as much as possible.

Table 2. The contribution of phased indicator changes to resilience enhancement

Index		1997-2001		2002-2010		2011-2019		2020-2022	
		Contribution Amount	**Contribution Rate (%)**	**Contribution Amount**	**Contribution Rate (%)**	**Contribution Amount**	**Contribution Rate (%)**	**Contribution Amount**	**Contribution Rate (%)**
RESI	R_f	0.009	77.06	0.048	75.72	0.085	43.13	0.076	40.09
	R_i	-0.003	-22.94	0.015	24.28	0.112	56.86	0.092	52.11
R_f	R_{f1}	0.013	57.02	0.085	37.60	0.156	29.24	0.143	30.23
	R_{f2}	0	1.27	0.056	24.76	0.145	27.26	0.131	23.43
	R_{f3}	0.010	41.71	0.085	37.65	0.231	43.50	0.210	39.39
R_i	R_{i1}	0.006	29.81	0.035	90.84	0.086	58.07	0.080	60.32
	R_{i2}	-0.003	-11.67	-0.001	-1.48	0.006	4.27	0.009	5.45
	R_{i3}	-0.013	-58.52	-0.003	-7.68	0.068	46.20	0.092	51.32

5. Conclusion and Implications

This article measures the resilience of China's high-tech manufacturing industry and empirically analyzes its impact effects. The study found that from 1997 to 2022, the resilience of China's high-tech manufacturing industry showed a fluctuating growth trend in stages, mainly divided into four growth stages: resilience negative growth stage, low-speed growth stage, rapid growth stage, and impact transformation stage. Innovation and transformation are the main factors affecting industrial resilience. Innovation enhances the industry's ability to withstand cycles and risks by improving its core competitiveness, while transformation reduces or disperses the risks and costs of industries under strong external shocks through diversified and decentralized business models. In the long run, enhancing industrial innovation and transformation can increase the resilience level of high-tech industries with certainty. Based on the above research conclusions, this article summarizes the following insights:

Firstly, the internal foundation of China's high-tech manufacturing industry is gradually consolidating, but its resilience and recovery ability to cope with global shocks are insufficient. China's high-tech industry needs to strengthen its corporate strength and global risk response mechanisms. On the one hand, enterprises should expand their scale and influence through mergers and acquisitions, strategic partnerships, and other means to enhance their voice in the global industrial chain. On the other hand, the government takes the lead in establishing a global risk monitoring and response platform, collaborating with industry associations and enterprises to anticipate and formulate strategies for responding to global shocks, such as trade frictions, global pandemics, and other events.

Secondly, the liquidity of funds has become increasingly important for the resilience of industries under global shocks, and the scale and influence of enterprises are not strong enough. China's high-tech industry needs to ensure liquidity and innovation investment. On the one hand, financial institutions should customize flexible financial products for high-tech manufacturing industries to ensure that enterprises have sufficient funds to maintain operations during global crises, such as setting up special emergency loans. On the other hand, the government has increased financial subsidies and tax incentives for innovation in high-tech manufacturing, established innovation special funds, guided enterprises to increase research and development investment, encouraged industry university research cooperation, and accelerated the transformation of innovation achievements.

Thirdly, innovation is a key factor in fracture toughness, while robustness has a significant impact on impact toughness. Transformability is crucial during external impacts. China's high-tech manufacturing industry needs to stabilize industrial development and promote transformation. On the one hand, the government has introduced long-term and stable industrial support policies, such as land use incentives and energy security, to ensure the steady development of high-tech manufacturing. On the other hand, building an industrial transformation service platform to provide enterprises with transformation consulting, technology docking, market expansion and other services, encouraging enterprises to actively transform into emerging high value-added fields when facing external shocks, such as transitioning from traditional electronic manufacturing to quantum computing related industries.

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