The impact of innovation & entrepreneurship on the structural updating for certain industry based on empirical analysis

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Abstract. During the COVID-19, the recovery of the world economy is facing a severe challenge. Specifically, a revolution in science and technology is developing in depth and due to the change of global economic industrial transformations are taking place gradually. For the sake of analyzing the effects of innovation and entrepreneurship on the upgrading of industrial structure (UIS), this study uses the data of the number of scientific and technological achievements, fiscal expenditure and industrial structure in China from 1995 to 2019 were selected as the research variables. Besides, the correlation between variables was analyzed based on vector autoregressive model (VAR), Johanse cointegration test, VECM, and also impulse response analysis. Empirical analysis indicates that a long-term equilibrium relationship exists between innovation and entrepreneurship, fiscal expenditure and the upgrading process. Innovation and entrepreneurship and fiscal expenditure have a positive effect in promoting the structure. These discussions shed light on guiding further exploration of guiding the main path break-throughs and policy management in the new era.

Keywords: Industrial structure upgrading; Time series; Cointegration test; VECM.

1. Introduction

In general, innovation and entrepreneurship can not only create wealth for society and improve the level of economic development, but also create new jobs, which has a long-term and far-reaching positive impact on solving the problem of unemployment and stimulating economic growth.

This paper first reviews and sorts out the relevant literatures on innovation and entrepreneurship and industrial structure upgrading. Subsequently, a model is built according to economic significance, to conduct empirical research. The Eviews software is utilized to prove the impact of innovation and entrepreneurship on the upgrading of industrial structure (UIS), and to obtain the long-term and short-term impact of innovation and entrepreneurship for it. It is aimed to study the impact of innovation and entrepreneurship and fiscal expenditure on the UIS.

As a matter of fact, UIS is a necessary path for developing countries to boost their economies in the later stages of development and seek new economic development momentum, and is also the core indicator of the development difference between the economies of developing countries and the economies of developed countries [1].

Researches on innovation and entrepreneurship and industrial structure upgrading mainly focus on the influence of the two features on the variation of economic. Most of these scholars believe that entrepreneurship has a significant positive impact. To be specific, Morris found that start-up type and survival type entrepreneurship both have a limited impact on economic growth, and that managed growth entrepreneurship can significantly promote economic growth as high-growth entrepreneurship do [2]. The UIS is the process of industrial absorption of technological innovation and self-optimization, while the industrial economic sector is replaced and renewed in turns by itself. [3]. With regard to the effect of UIS on economic growth, Braunerhjelm selected 17 OCED countries to affirm that entrepreneurship at the overall level has a significant positive impact [4].

When studying the important role of the entry of new enterprises in industrial restructuring, Noseleit found that the level of entrepreneurial activity that affects economic growth. Moreover, the entrepreneurial ability to promote industrial restructuring by redistributing cross-sectoral organizational factors, which has a greater role in promoting economic growth [5]. Wang and Yan used the 1998-2013 China Interprovincial Panel Data Regression to find that entrepreneurship can significantly boost economic growth [6]. Thukral stated that the COVID-19 has led to strategical

behavioral changes on enterprises, especially on SMEs, which are responding to the crisis through innovation and differentiation [7].

After dividing the UIS into industrial structure rationalization and optimization, Gan claimed that the rationalization of industrial structure has a steady effect while the relationship between optimization of industrial structure and economic growth is uncertain. Industrial optimization brings fluctuations to the economy in the process, but industrial rationalization would calm this fluctuation [8]. Yi is committed to summarizing the historical experience and regular characteristics of industrial evolution in developed countries [9]. The conclusion is that China's industrial upgrading should not be limited to the upgrading of the service industry, but also ought to realize the optimization and upgrading of the manufacturing industry, and the core lies in accelerating the adjustment of the economic operation mechanism. Different from other scholars who study the degree of influence between indicators, Li used BP neural network to predict the coupling and coordination development [10].

Based on the above research, the author plans to divide the UIS into optimization and rationalization on the basis of existing research. With this in mind, this paper will use the index of industrial structural optimization to evaluate the impact of innovation and entrepreneurship on industrial structure upgrading in terms of empirical analysis with time series model. The reminder sections for this study will be presented as follows. The Sec. 2 will demonstrate the sources and meanings of data and model. The Sec. 3 will explain the steps and causes of empirical analysis through quantitative methods, and present the processes and results obtained. The Sec. 4 will combine the data with the previously mentioned theories and attempt to provide constructive advice to the government based on this. By reviewing the article the Sec. 5 will reflect on the limitations of this paper and make a bold outlook on this topic. In the end, Sec. 6 will give a conclusion to this paper.

2. Data & Method

2.1 Data sources and descriptions

This article selects sample data from 1995-2019 for analysis. On the one hand, based on the availability of variable data, the data from 1995 on-wards is selected. On the other hand, in order to make the results of the study closer to the current situation, the data is as of 2019. All data in this article comes from the National Bureau of Statistics.

As for industrial structural optimization index TS, the connotation of UIS has two indicators: optimization and rationalization of industrial structure. The empirical research part of this paper mainly studies the index of industrial structural optimization. The ratio between tertiary and secondary industry is chosen as the indicators of structural optimization, where the variable is recorded as TS. The level of innovation and entrepreneurship can be measured by different indicators. This paper takes the annual number of scientific and technological achievements registered as a measure of innovation and entrepreneurship level, recorded as CG. Regarding to fiscal expenditure FIN, the ratio of regional fiscal expenditure to the GDP of the region are adopted to measure the fiscal system, and the variable is recorded as FIN. Before the empirical analysis, all variable data is treated naturally logarithmically, which avoids the impact of heteroscedasticity and exponential trends, and preserves the relationship between the data.

2.2 Model building

Theoretical analysis shows that innovation and entrepreneurship and financial investment will affect the UIS. This paper sets the following cointegration equation to test the long-term on the upgrading of industrial structure:

$$lnTS_t = \alpha_t + \beta_1 lnCG_t + \beta_2 lnFIN_t + \epsilon_t \quad (1)$$

To mitigate the volatility and heteroscedasticity of the data, the natural logarithm is taken for all of the above variables.

3. Empirical analysis

3.1 Stationarity test-unit root test

Before performing empirical analysis, to prevent spurious regression problems, a unit root test is necessary for the selecting variables. To ensure the robust-ness of the results, the ADF test method is used in this article. The results shown in Table 1 denotes that the three variables are all integrated of order one.

Table 1. The unit root test results (ADF method).

variable	ADF value	P value	1%	5%	10%	conclusion
LnCG	0.972799	0.9948	-3.737853	-2.991878	-2.635542	non-stationary
DlnCG	-4.182526	0.0038	-3.752946	-2.998064	-2.638752	stationary
Lnfin	0.637763	0.9989	-4.532598	-3.673616	-3.277364	non-stationary
Dlnfin	-4.969284	0.0043	-4.532598	-3.673616	-3.277364	stationary
Lnts	-1.239546	0.1912	-2.669359	-1.956406	-1.608495	non-stationary
Dlnop	-2.196538	0.0298	-2.669359	-1.956406	-1.608495	stationary

3.2 Johansen cointegration test

The level time series of the logarithmic values of the three variables of China's industrial structure, scientific and technological achievements, and fiscal expenditure is not stable. Besides, it is stable after the first-order difference. To test whether this long-term equilibrium relationship exists, a Johansen cointegration test is performed on the equal three variables to determine whether there is a cointegration relationship between the three. To ensure the statistical credibility of the cointegration relation, firstly one needs to set a reasonable order of cointegration lag. Seen from Table 2, order one can be regarded as the optimal case. Since the establishment of the VAR model requires stationarity of the data, and the ADF test above can tell its robustness, so the VAR model is able to be established. After determining the lag order, the Johansen test can be used for the cointegration analysis followed.

Table 2. The best lag order of VAR model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	41.04133	NA	7.35e-06	-3.307942	-3.159834	-3.270693
1	134.8973	155.0663*	4.63e-09*	-10.68672*	-10.09429*	-10.53773*
2	141.1628	8.717294	6.17e-09	-10.44894	-9.412187	-10.18820

***, **, and * indicate significance of 1%, 5%, and 10%, respectively

Table 3. Johansen cointegration test results(Trace)

Hypothesized	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.739087	52.38420	29.79707	0.0000
At most 1 *	0.592542	22.82570	15.49471	0.0033
At most 2	0.130392	3.073693	3.841466	0.0796

p=0.05

Table 4. Johansen cointegration test results

Hypothesized	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.739087	29.55850	21.13162	0.0026
At most 1 *	0.592542	19.75200	14.26460	0.0061
At most 2	0.130392	3.073693	3.841466	0.0796

p=0.05

Results from Table 3 and Table 4 indicate a cointegration relationship, i.e.,a long-term equilibrium relationship exsits between the three variables above. In addition, it also denotes that it is feasible to use the VECM for further research.

3.3 Establish the VECM

After passing the Johansen cointegration test and determining the lag order of the model, the analysis result of VECM is shown in Table 5. According to Table 5, one can also establish the cointegration equation below about industrial structure updating:

$$Lnurb = 0.574611lnCG + 0.316064lnFIN - 5.580292 \quad (2)$$

The coefficients of each variable have passed the significance test, indicating that in the long run, fiscal expenditure, scientific and technological innovation will have a significant impact on the UIS. Judging from the symbols of each coefficient, fiscal expenditure, scientific and technological innovation will promote the upgrading. This is because in the long run, fiscal expenditure will promote economic growth, further promote the UIS, and attract more rural residents to cities and towns. At the same time, the government's fiscal expenditure will also support some of the new tertiary industries. The results of the residual correction test proved that the stable conditions were met (Fig 1,Table 6). White Heteroscedasticity test results prove that there are no heteroscedasticities in the model

Table 5. VECM estimated results.

Cointegrating Eq:	CointEq1		
LNURB(-1)	1.000000		
LNCG(-1)	-0.574611		
LNFIN(-1)	-0.316064		
C	5.580292		
Error Correction:	D(LNTS)	D(LNCG)	D(LNFIN)
CointEq1	-0.272881	-0.335791	-0.063023
D(LNTS(-1))	0.071721	-0.594675	-0.370011
D(LNTS(-2))	0.150440	0.416492	0.153377
D(LNCG(-1))	-0.242905	-0.237875	-0.281662
D(LNCG(-2))	-0.057730	-0.560944	0.049488
D(LNFIN(-1))	0.251248	0.206752	0.618447
D(LNFIN(-2))	-0.194795	-0.576401	-0.170354
C	0.030094	0.080453	0.032078

Notes: VECM has already pass all analysis.

Table 6. Residuals test result

Root	Modulus
1.000000	1.000000
1.000000	1.000000
-0.223124 - 0.723142i	0.756781
-0.223124 + 0.723142i	0.756781
0.751983	0.751983
0.478801	0.478801
0.285716 - 0.255359i	0.383200
0.285716 + 0.255359i	0.383200
0.036311	0.036311

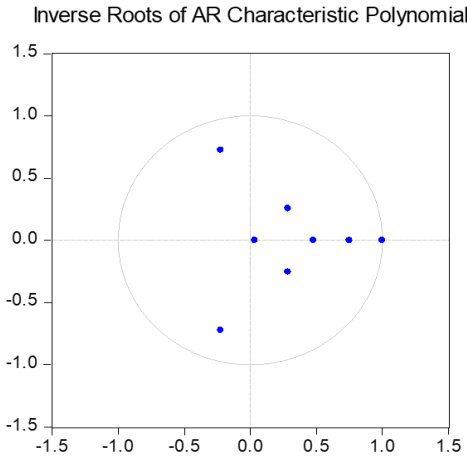

Fig. 1 Residual robustness test plot.

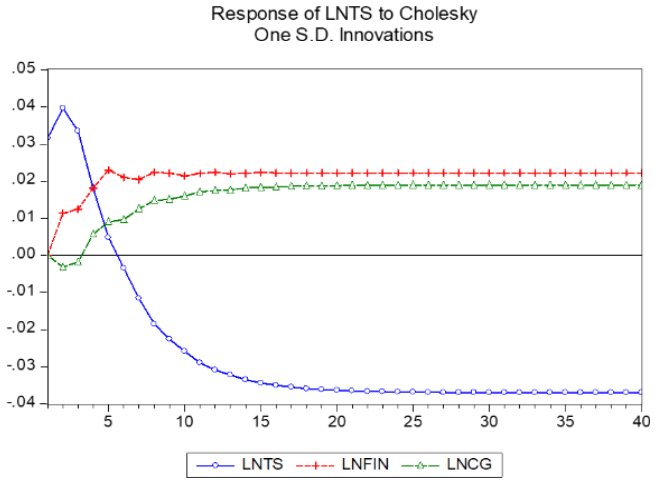

Fig. 2 Impulse response plot.

3.4 Impulse response analysis

In order to investigate the dynamic influence of innovation and entrepreneurship and fiscal expenditure on industrial structure upgrading, this paper plots the impulse response function plot of the impact of each variable on the current and future periods of industrial structure upgrading after being impacted by a standard deviation, and the results are shown in Fig 2

Seen from the Fig 2, after the CG in this period is affected by a positive impact of one unit, LNTS will produce a small decline in the first two periods, and then gradually increase in the 3rd to 12th periods. Till the 16th period, this impact reaches a peak at 0.017, and remained stable around 0.017 ever since. This shows that in the short term, innovation and entrepreneurship may have two weak negative impacts on the UIS, and then quickly transform into a positive impact, promoting the process of industrial structure upgrading, and this impact has a long-lasting effect.

After the FIN of this period is affected by a positive impact of one unit, the industrial structure optimization index will increase rapidly from the 2nd to the 5th period. This impact will reach a peak of 0.023 by the 5th period, and it will remain stable around 0.021 after a slight decline. On this basis, the short term, the increase in fiscal expenditure will promote the growth of industrial structure upgrading, and this impact has a significant promotion effect and a long-lasting effect.

3.5 Variation partition analysis(VPA)

VPA provides a method in which the fluctuations of an explanatory variable are given, the contribution of other variables to total variation in VECM can be decomposed or divided. To be simple, VPA determines the proportion of the specified environmental factors' contribution to changes during structural volatility.

In short term, the UIS is the most important contributor itself, and the contribution rate of more than 75% has been maintained in the first five periods. Over the long term, its contribution rate gradually decreased, to 60% after the 30th period. The contribution rate of fiscal expenditure to the UIS increased significantly in the first five years, its impact contribution rate reached 33.7% after a decade of growth, followed by a slight decrease in the period from 10 to 35 years, reaching 24.09% after 40 years.

The impact of innovation and entrepreneurship on the UIS is a gradual process of increasing, the first ten years of rapid growth, the impact contribution rate increased to 10.56% in the tenth year, slowly increased during the 10th to 30th year, reaching 15%, and stabilized at 15.5% in the follow-up.

The policy significance of the decomposition results is that in the process of China's structural upgrading, innovation and entrepreneurship and fiscal expenditure have contributed to the UIS, and the growth rate and effect of their contributions are slightly different. The detail results are demonstrated in Fig. 3.

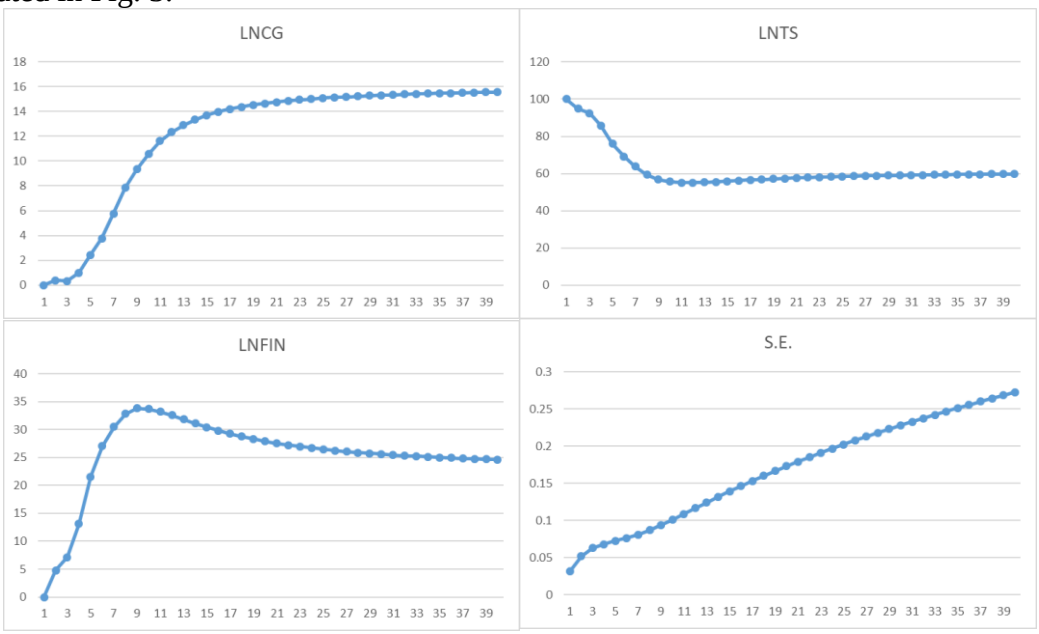

Fig. 3 Charts of VPA results.

4. Suggestions

4.1 Increase support for innovation and entrepreneurship

Innovation and entrepreneurship is an important force to promote the development of the country, the nation and even the entire human society. In policy, it has always been the focus and repeated emphasis of a developing country. China's proposal to deeply promote the structural reform of the supply side has been continuously implemented and promoted in the context of the vigorous development of the ecology of mass entrepreneurship and innovation in recent years. However, at the same time, there are some problems that also show that the current situation is imperfect. The problems of low conversion rate of technological achievements, and low depth of international cooperation still exist.

The government should create an upgraded mass entrepreneurship and innovation to promote the high-quality de-velopment of innovation and entrepreneurship. In this case, it is necessary to promot the development of industrial structure upgrading, which is of great significance to enhancing the en-dogenous driving force of economic development.

4.2 Strive to promote the upgrading of the environment for innovation and entrepreneurship

The directions and forms of innovation and entrepreneurship are diverse. In the process of promoting the UIS, it is necessary to grasp the main direction and model choice of innovation and entrepreneurship. The government should have a direction and reasonable way to promote innovation and entrepreneurship, and try to better serve the UIS for development. To be specific, it is necessary to enhance the ability of entrepreneurship to drive employment and scientific and technological innovation, accelerate the cultivation of new momentum for development, fully stimulate market vitality and social creativity, and create a hotbed for china's high-quality economic development.

5. Limitation & Future outlooks

The contents presented in the previous parts of this article are based on empirical partial regression results. However, owing to the constraints of objective conditions (e.g., research ability and data collection), there are still many shortcomings in this paper, which need to be further studied in depth. So far, this paper is still about industrial upgrading, and there is a lack of proven data and quantitative methods on Industrial rationalization. Afterwards, it is believed that there will be a theory to make a clearer mechanism analysis and more comprehensive judgment for this topic.

6. Summary

In conclusion, this paper investigates influencing factors of UIS based on time-series modeling. To be specific, in terms of Macro time series data from 1995 to 2019, a VECM was established to discuss the short-term and long-term impact of innovation and entrepreneurship and fiscal expenditure on industrial structure upgrading. According to the analysis, the short-term impact of innovation and entrepreneurship on UIS is significantly positive, and the long-term impact is significantly positive. The short-term impact of fiscal expenditure on the UIS is significantly positive, and the long-term impact is significantly positive. Both innovation and entrepreneurship and fiscal expenditure have had a positive impact on the UIS. Nevertheless, the mechanistic analysis of industrial rationalization is still needed to be further explored. In the future, one may have a widely accepted theory for that and by synthesizing that to make a unified judgment. Overall, these results offer a guideline for the current analysis and government management on relationship between innovation and economic development.

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