

An empirical study on the relationship between industrial structure and economic growth in Hefei City

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ABSTRACT

When a city's economy continues to improve and its growth rate is striking, it becomes the centre of discussion. This is the case of Hefei, with decades of development from a precariously small city to become a quasi first-tier city, which is worth analysing and exploring. This paper starts from the industrial structure of Hefei City to study why Hefei has developed so rapidly, to find the reasons for its economic take-off, and to provide ideas and methods for other scholars to study the causes and results of the economic development of big cities. Based on this, the paper selects the gross domestic product of Hefei in the past 40 years, takes the growth rate of gross domestic product as the benchmark to explore the causes of economic growth, and collects the changes of the proportion of different industries in the gross domestic product of Hefei to explore the results of its influence, and introduces other disturbing factors such as the growth rate of labour force and the amount of investment, in comparison with the industrial structure. Under this investigation, the results show that the economic growth of Hefei City is indeed related to the change of industrial structure, especially the transformation of the secondary industry to the tertiary industry is more obvious, and the level of labour and investment is also positively correlated with the economic growth; this requires that Hefei City must accelerate the change of the industrial structure, increase the proportion of high and new-tech industries, and increase the support of the working population in order to maintain a stable and long-term economic growth. In order to maintain a stable long-term economic growth, Hefei must accelerate the change of industrial structure, increase the proportion of high-tech industries, and increase the support for the labour force, as well as ensure the effective allocation of resources.

KEYWORDS

Industrial structure; Economic growth; Hefei

1 Significance of the study

1.1 Theoretical significance and practical significance

Various studies at home and abroad have confirmed that there is a bond between industrial structure and economic growth, when a country in the long process of development will inevitably be accompanied by changes in the industrial structure, from the beginning of the primary industry such as agriculture and forestry, to the petroleum-based secondary industry, and then to the modern development of high-tech and rapid development of the service industry, and at the same time with the development of the economic growth, in the constant change of the industrial change gives society a huge accumulation of wealth, while economic growth also makes the change of industrial structure more advanced and rational. In the course of continuous change, industrial change has given society a huge accumulation of wealth, while economic growth has also made the change of industrial structure more advanced and rationalised.

As the capital of Anhui Province, Hefei has not only accelerated its urbanisation process but also its economic development in the past decades, regional cooperation and exchanges with other cities are also very active, and the urban city circle centred on Hefei has gradually formed. Behind the rapid economic and social development of Hefei, there are also many problems, combined with the adjustment of industrial structure, in-depth analysis of the relationship between industrial structure and economic growth in Hefei and the process, which is not only to promote the upgrading of the industrial structure of Hefei and the coordinated development of Hefei has an important significance but also to improve the important role of the urbanisation of industrial structure adjustment.

1.2 Overview of industrial structure for economic growth

In recent years, scholars in various countries have outstanding research and attention to industrial structure and economic growth. Rodrik (2016) believes that increasing the total amount of tertiary industry in a country in the process of development will have the opposite effect on the growth in its economy, and it is necessary to be gradual. Peter Havlik (2015) believes that the economic growth in some cases is the cause of the industrial structure also is the result of the continuous development of industrial structure. Sun Wenlong (2021) concludes through a study on the innovative capacity of regionalisation on the economic industrial structure of the economy in terms of preferential upgrading and economic growth. Li Min (2019) argues that economic growth and industrial structure upgrading is an inverse benefit, proposing that there is a trend of structural decline in China, and there is also a positive benefit of industrial and institutional rationalisation and upgrading on economic growth, the accelerated rate of economic growth makes the

industrial structure and employment mode change rapidly, and the degree of normalisation of industrial structure is getting lower and lower. Xiong Yunjian (2018) looks at the relationship between the two in terms of people themselves, arguing that it is the human element of labour that promotes social change and thus affects the overall economic development. Zhao Jingrui et al. (2021) through the direction of the development of the enterprise industrial structure, that is, the green environmental class of enterprises in the whole industry has the strongest sustained economic benefits, and has been on the rise.

2 Current situation of industrial structure and economic growth in Hefei city

2.1 Analysis of industrial structure

2.1.1 Analysis of the current situation of industrial structure in Hefei city

Table 1 and Table 2 present the data of Hefei's GDP for more than 20 years since 2001, while Hefei's economy is taking off, the proportion of primary industry, secondary industry and tertiary industry is also undergoing a significant change, and the proportion of the total value of the different industries in 2023 is 2.98%, 36.63% and 60.39% respectively. It can be seen that in the industrial structure of Hefei City, the total value of the tertiary industry is in the leading position, the primary industry is slightly behind, and the secondary industry is second. So Hefei city has gradually made the industrial structure show the pattern of "three, two, one" after twenty years of development.

Table 1 Total value of industry in Hefei over the years Unit: billion

vintages	Total value of industries
2001	559.53
2005	1074.28
2010	2976.08
2015	5830.95
2016	6544.26
2017	7366.64
2018	8605.13
2019	9370.69
2020	10005.56
2021	11412.80
2022	12008.08
2023	12673.78

Source: Hefei Statistical Yearbook.

From 1980 to 2023 in Table 2, the gross domestic product (GDP) of Hefei City has shown a steady upward trend for more than forty years, but the growth rate is different. 2010 is a major turning point, before that, the gross domestic product of Hefei City's industrial structure is in a slow growth process, the growth rate of the primary industry belongs to the steady increase, and occupy the big head of the gross domestic product of the economy or to Mechanised production is the main secondary industry, at this time the tertiary industry accounted for a relatively low. After entering 2015, the development of the tertiary industry is advancing by leaps and bounds, and the economic benefits brought by the tertiary industry are obvious, and the GDP of Hefei City's regional industry is also increasing gradually.

Table 2 Changes in industrial structure of Hefei Unit billion yuan

vintages	primary sector of industry	secondary sector of industry	industries	tertiary sector of industry
1980	4.18	6.80	6.16	3.17
1990	16.72	26.36	22.83	15.11
2000	60.60	208.71	178.47	218.19
2005	84.01	444.77	323.48	545.46
2010	172.54	1382.65	898.64	1420.89
2015	256.53	2480.46	1544.78	3093.96
2016	262.32	2719.86	1719.65	3562.08
2017	270.07	2909.34	1772.72	4187.23
2018	277.59	3169.98	1834.78	5157.56
2019	291.86	3341.51	1920.48	5736.84
2020	335.21	3535.79	2051.76	6134.91
2021	351.05	4171.67	2472.25	6890.54
2022	382.01	4344.01	2590.71	7275.91
2023	377.20	4642.21	2813.31	7654.38

Source: Hefei Statistical Yearbook.

2.2 Analysis of the current situation of economic structure and employment structure in Hefei city

2.2.1 Analysis of the current situation of the economic structure of Hefei city

(1) Steady improvement in the post-epidemic era, with obvious benefits for the primary sector.

In 2023, the primary sector still showed a favourable development trend after the heavy disturbance of the epidemic year. The total value of the primary industry for the whole year was 37.720 billion yuan, with a growth rate of 1.7% compared to 2020. The growth rate of agricultural products maintained a better growth rate compared to other industries, with a year-on-year growth rate of about 4.1 per cent.

(2) The growth rate of the secondary industry is obvious, and the efficiency of various fields continues to improve.

In 2023, the annual industrial output value maintained a good growth rate, the total value added of the production of the secondary industry for the year reached 281.331 billion yuan, relative to last year, the increase in the production rate of 8%. The secondary industry currently has a considerable scale effect, in electronic technology, automobile parts, flat panel display and other industries due to its volume and overall advantages, during the same period of time increased by 25.1 per cent, 25.9 per cent and 29.4 per cent respectively.

(3) Recovery of growth in the tertiary sector and continued improvement in the high-tech sector.

The tertiary industry is now a pillar industry in Hefei, and with the help of the government and its own strength, it was at an overall high level at the end of 2023. In the fourth quarter, the total value added of services more than doubled that of the third quarter, and the gross domestic product of the tertiary industry for the whole year was 765.438 billion yuan, with a year-on-year growth rate of 15.2 per cent. In addition to this, the high-tech service industry is also in a stable and improving stage.

2.2.2 Analysis of the current situation of employment structure in Hefei city

According to Table 3 and Table 4, in 2023, the number of employees in Hefei City is 5.019 million, while the number of employees in Anhui Province is 9.366 million, accounting for 52.32% of the total. The number of employed people in primary industry is 450,900, accounting for 10.2% of the total proportion; the number of employed people in secondary industry is 1,723,000, accounting for 32.6%; the largest number of employed people among the three major industries is in the tertiary industry, which occupies the largest proportion and accounts for 57.2% during the same period, and the structure and mode of the overall employment also shows the "three, two, one" pattern. The overall structure and mode of employment also showed a "three, two, one" pattern.

Table 3 Citywide Employed Population and Share of Each Industry, Hefei City, 1980-2023

vintages	Employed persons (10,000)	primary sector of industry	secondary sector of industry	tertiary sector of industry
1980	145.9	102.9	24.8	18.2
1985	181.3	109.6	38.9	32.8
1990	203.7	116.6	47.8	39.3
1995	234.1	105.0	72.8	66.9
2000	237.2	109.0	68.7	94.1
2005	256.3	81.4	115.3	147.8
2010	344.5	81.4	115.3	147.8
2015	457.0	74.5	160.4	222.1
2020	490.1	50.1	159.8	280.1
2023	501.9	45.09	172.3	284.5

Source: Baidu Search

3 Empirical analysis of economic development on industrial structure upgrading

3.1 Selection of variables

3.1.1 Explanatory variables

The core explanatory variable selected for this paper is the amount of change in the GDP of the three industries as a percentage of the overall GDP in the development process of Hefei City. In addition to the following three kinds: the first is the labour force growth rate, the more social workers, the more conducive to economic growth, the expected result is positive. The second is the level of enterprise investment, this paper uses the enterprise liquid assets economic investment in GDP ratio to measure, the investment will produce certain economic benefits, can promote economic development, the expected results are positive. The third is the level of investment in fixed assets, the paper uses fixed asset investment as a proportion of GDP to measure, fixed assets can increase the amount of money used in the market

economy and the use of the rate, can effectively promote economic growth, the forecast and its results are positive.

3.1.2 Explained variables

The explanatory variable used in this paper refers to the growth rate of Hefei's GDP, which is generally divided by the total value of the following year minus the total value of the previous year, and the resulting positive result represents an increase in the economy, while the opposite is a decrease.

Table 4 Definitions of Regression Model Variables

define	variant	Description of variables	predicted effect
explanatory variable	Economic growth i.e. the growth rate of Hefei's GDP RGDP	Refers to the positive aspects of GDP over a period of time.	
	Labour force growth rate RL	Labour force growth rate	+
	Level of business investment BIV	This paper uses the ratio of firms' economic investment in current assets to GDP	+
control variable	Level of investment in fixed assets INV	Investment in fixed assets as a share of GDP	+
core variable	industrial structure ISC	Share of different industries in economic growth	+

3.2 Model construction and data sources

3.2.1 Modelling

Heteroskedasticity may bias the results of the regression, and in order to address this situation, the data used in the article will be logarithmised. The following model is developed:

$$\ln Y = C + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \varepsilon$$

Where C is the universal constant and ε is the other perturbation term. X_4 After analysis, in addition to the impact of changes in industrial structure, investment capital injection factors also have a greater impact on the economic growth of Hefei City, for this reason, the main factors to be considered are the growth rate of the labour force in Hefei City X_1 , Hefei City, the level of investment in enterprises X_2 , Hefei City, the change in the investment volume factor X_3 , changes in the industrial structure of the Hefei City, in order to more detailed study of Hefei City, industrial structure of the impact of the economic growth of the problem, this paper is split into economic growth of the overall economy and the first, second and third industries. The overall economy and the economic growth of the first, second and third industries.

3.2.2 Data sources and descriptive statistics

This table uses the data of the incremental change rate of the three major industries in Hefei City from 1980 to 2023, the gross domestic product (Hefei GDP), the proportion of the primary industry's GDP, the proportion of the secondary industry's GDP, the proportion of the tertiary industry's GDP, the level of enterprise investment and the data of the fixed assets are all from Baidu Encyclopedia and Hefei Data and Statistics Yearbook, and the results of the descriptive statistics are calculated according to the change of the year of the industrial structure and the level of investment of the fixed assets. The descriptive statistics results are shown in the table below:

Table 5 Descriptive Statistics of Industrial Structure in Hefei City

VARIABLES	N	Mean	Std.	Min	max
LNRL	150	3	1.419	1	5
LNRGDP	150	5.125	0.469	3.723	5.714
LNINV	150	5.214	0.649	3.154	6.082
LNBIV	150	5.459	0.616	4.146	6.544
LNPCI	150	7.866	0.965	5.407	9.337
LNISC	150	4.856	0.886	2.789	11.261

3.3 Regression models and analyses of industrial structure changes and multifactor changes on economic growth

3.3.1 Unit root test

A credible data analysis result needs to start with a panel data unit root test. We begin with a unit root test for the gross product GDP of Hefei City over 40 years, and in Table 6 the resulting ADF test is -2.732, with a 1% significance level of -4.352, a 5% significance level of -3.584, and a 10% significance level of -3.233, and the test value of the explanatory variables is greater than all three, so that the explanatory variables show an unsteady status. The explanatory variables are smooth in the test after the first-order difference, so regression analysis can be carried out.

Table 6 Unit root test and difference test

variant	ADF test value	Test value at 1% significance level	Test value at 5% significance level	Test value at 10% significance level	P-value	Test results
LNGDP (unit root test)	-2.732	-4.352	-3.584	-3.233	0.0037	uneven
LNGDP (second order difference)	-4.253	-4.352	-3.588	-3.233	0.0021	uneven
LNDR (second-order differential)	-5.792	-4.352	-3.584	-3.233	0.0000	smoothly
LNDINV (second order differential)	-5.818	-4.352	-3.584	-3.233	0.0015	smoothly
LNVBIV (second order difference)	-5.279	-4.352	-3.584	-3.233	0.0014	smoothly
LNVPIC (second-order differential)	-5.332	-4.352	-3.584	-3.233	0.0007	smoothly
LNISC (second-order differential)	-5.889	-4.352	-3.584	-3.233	0.0021	smoothly

3.3.2 Cointegration analysis

The residual series in the GDP need to be tested before conducting the cointegration test. We firstly still logarithmise the independent and dependent variables, where β_0 is the parameter term and ε is the random disturbance term, and then use stata software to conduct the test. We first set up the cointegration equation as follows:

$$LNGDP = \beta_0 + \beta_1 LNIND + \beta_2 LNINV + \beta_3 LNBIV + \beta_4 RL + \beta_5 ISC + \varepsilon$$

Table 7 Cointegration analysis

LNGDP	Coef	Std.Err	T	P> t	[95 per cent Conf. Interval]	
LNRL	0.1693726	0.0867686	1.95	0.061	-0.0086618	0.3474075
LNINV	-0.0877747	0.1232346	-0.70	0.491	-0.3463275	0.1708328
LNBIV	0.0131533	0.0408335	0.32	0.75	-0.0704925	0.0967966
LNISC	0.7299652	0.321168	4.05	0.028	0.06417711	0.1957535
ECM	-0.0001541	0.013548	-0.28	0.027	0.15454155	0.5545155
_CONS	0.1540094	0.379878	2.28	0.036	0.0761949	0.2318239

According to the above Table 7, it can be seen that for every 1% change of the explanatory variables, the explained variables change by 0.729%, which obviously concludes that the change of the industrial structure has a positive effect on the growth of the economy, which is consistent with the previous prediction results. And then through Table 8 can be obtained, the ADF test value -3.866 is smaller than -3.736, proving that its residual series is smooth, so the industrial structure and economic growth is cointegration.

Table 8 Residual series test

variant	ADF test value	Test value at 1% significance level	Test value at 5% significance level	Test value at 10% significance level	P-value	Test results
residual	-3.866	-3.736	-2.994	-2.628	0.0051	cointegration (math.)

3.3.3 Regression analysis

According to the above analysis there is a cointegration relationship between the two, the error correction model is now carried out and the test results are shown in the following equations:

$$LnGDP = 0.014 + 0.59LnRL - 0.70LnINV + 0.32LnBIV + 0.95LnISC - 0.28ECM$$

As shown by the formula of the above model, the coefficient of the ECM before correction and the coefficient of the correction of the metropolis a relatively small value, the model performs better in the long-term equilibrium, but the coefficient is negative, still shows that the correction still tends to the equilibrium level. In terms of variables, the value of labour rate coefficient is 0.59, which is better for economic growth; INV is -0.7, which means that the two are negatively correlated, and the core variable of ISC is 0.95, which shows that the industrial structure has a positive effect on economic growth.

4 Conclusions and policy recommendations

4.1 Main findings

Hefei is currently in the "new normal" stage, is in the transition of Hefei is undoubtedly a powerful whirlwind, service-based tertiary industries are pulling the economy of Hefei at a rapid pace. In the new stage of Hefei's development, we need to recognise the current lack of comprehensive strength of Hefei, industrial scale efficiency is too low, the serious imbalance of resource tilting and other issues, and insufficient investment in high-tech industries. In the next stage of development, Hefei needs to give better solutions to these problems.

4.2 Policy recommendations

4.2.1 Exacerbating industrial agglomeration effects

As mentioned above, the city of Hefei as a whole suffers from a lack of knowledge and innovation as well as a lack of comprehensive strength, as it is in itself a city in which each industry is its own, and where there is no joint development, and where the advantages cannot be expanded. Moreover, Hefei City is led by the high-tech production industry, which is mainly industrial, and it is necessary to put its technological innovation into production, to expand its scale effect through joint operation, in order to increase the value of other than itself, so that better commodities can seek a better market, and to obtain the possibility and necessity of long term development through the co-operation of the industry and the enterprise.

4.2.2 Strengthening industrial innovation systems

Innovation is a business or industry enduring panacea, which is not only a business should do, but also a city and even a country should pay attention to the problem. Hefei City currently needs a good innovation system, from the city to the enterprise and then to the staff, need to maintain the spirit of innovation, to focus on continuous learning of industry knowledge, to continue to walk in the forefront of the times, to cultivate more scientific and technological knowledge of the talents, and improve the industrial innovation system.

4.2.3 Accelerating industrial modernisation

Hefei City, the resident population of nearly 10 million, but the overall population area suburbanisation, urbanisation overall development level is not high, a large number of labour force rural marginalisation, resulting in the city's secondary and tertiary sectors of the supply of personnel is insufficient, the current need for this type of situation to be transformed, optimise the urban structure, and to promote the development of the city. To increase support to agriculture, improve subsidies and other policy support, but also to protect agricultural workers in agriculture, so that more people into the secondary and tertiary sectors, so as to better improve the overall level of employment and urbanisation, large-scale mechanised production will have a more abundant labour force, improve labour productivity, which is to accelerate the process of industrial modernisation.

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