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Study on the Impact of Logistics Industry Agglomeration on Urban Economy: Evidence from Suzhou in China

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Abstract: The improved locational entropy index is used to calculate the level of logistics industry agglomeration in Suzhou based on time series data from 2001 to 2020. Based on the vector autoregressive model and vector error correction model, econometric methods such as the Granger causality test and impulse response are used to further examine the impact of Suzhou's logistics industry agglomeration on the city economy. According to the study, Suzhou's logistics industry agglomeration has a long-term positive impact on the city's economy, and there is a one-way Granger causality with long-term predictive value. The two-way correction mechanism causes the Suzhou logistics industry agglomeration to return to the long-term equilibrium state when there is a short-term deviation from the equilibrium state. As a result, logistics industry agglomeration in Suzhou is an essential factor for the development of the urban economy, and proper promotion of logistics industry agglomeration can drive urban economic development. The primary considerations are how the government can guide the logistics industry agglomeration and how to adjust the infrastructure and supporting facilities of the logistics industry agglomeration area.

1. Introduction

With the accelerated process of economic globalization and the vigorous development of Internet e-commerce, the scale of commodity circulation is expanding, the industrial structure is upgrading, and the logistics industry has become an immediate need of the entire modern society. With the rapid development of China's economy, the people's living standards are also steadily improving, the increase in disposable income stimulates the people's consumer demand, and the economic demand of major industries has driven the continuous development of the logistics industry. Suzhou is located in the Yangtze River Delta center hinterland, adjacent to Shanghai, its geographical position is unique, with the rapid development of the logistics industry, the annual business income in Jiangsu Province first. According to the information released by Suzhou Modern Logistics Chamber of Commerce in 2021, Suzhou logistics enterprises have reached more than 40,000, the logistics industry annual revenue of more than 300 billion yuan, accounting for nearly 14% of Suzhou's gross domestic product, an annual increase of 8%, the general growth in demand for key logistics industries, e-commerce, express, cold chain, railroad, and various multimodal logistics development[1]. At present, the manufacturing industry is converging in Suzhou, and the associated logistics industry is converging, so that it is fully promoting the Yangtze River Delta logistics to the national radiation, and collaborating to help the new development of the Yangtze River Delta logistics integration[2].

At present, the main form of logistics industry agglomeration in Suzhou is the formation of logistics agglomeration based on the existing logistics parks, which can be divided into free trade zone type logistics agglomeration, river port type logistics agglomeration, comprehensive logistics agglomeration, professional logistics agglomeration and supporting logistics agglomeration according to functional categories. The service objects of logistics clusters are mostly traditional logistics objects such as manufacturing and free trade, while professional service objects such as chain and IT have not yet been formed systematically. Taking Suzhou as an example, this paper further investigates the dynamic influence mechanism of logistics industry agglomeration on the economic development of Suzhou by studying its relevant statistical data from 2001 to 2020, so as expect to draw guiding conclusions and put forward relevant suggestions for urban economic development[3-4].

2. Selection of measurement indicators

2.1 Logistics industry agglomeration indicators

Logistics industry agglomeration is a quantitative concept that represents the ability of the logistics industry to agglomerate its production factors in a specific economic space region. It is an indicator concept introduced to quantitatively study the degree of logistics industry agglomeration. Generally speaking, the methods of quantitative analysis of industrial sub-clustering include locational entropy, Gini coefficient, EG index, Sill coefficient, etc[5].

In view of the characteristics of the logistics industry, the traditional location entropy measurement method does not take into account the labour productivity factor, and most of the regions have different staff quality and technology levels, which leads to some deviations between the measured results and the actual situation, forming certain limitations, making it difficult to find the real reasons affecting the agglomeration of the logistics industry and to make targeted proposals. Therefore, on the basis of the traditional location entropy measurement method, this paper will draw on the research results of Caifeng Li (2012) and select the improved location entropy with the introduction of labour productivity factor to measure the agglomeration of the logistics industry, and the specific calculation formula is shown in (1)[6].

$$U_{ij} = \frac{q_{ij}/q_j}{q_i/q} \times \frac{p_{ij}/q_{ij}}{p_i/q_i} = \frac{p_{ij}/q_j}{p_i/q} \tag{1}$$

In this equation, Uij represents the improved locational entropy; qij is the number of employed persons in industry i in region j; qj is the number of employed persons in all industries in region j; qi is the number of employed persons in the industry i in the high-level region; q is the number of employed persons in all industries in the high-level region; pij is the gross product of industry i in region j; and pi is the gross product of industry i in the high-level region. In addition, both the left and right sides of the multiplier are floating values above and below "1", so the improved locational entropy is also floating values above and below "1". Uij is larger than "1", which indicates a higher level of industrial agglomeration, and smaller than "1", which indicates a lower level of industrial agglomeration. A value greater than "1" indicates a high level of industrial agglomeration, while a value less than "1" indicates a low level of industrial agglomeration. The j region and i industry in the calculation formula is introduced into the Suzhou city and logistics industry studied in this paper, respectively, and the high-level region of Suzhou city in Jiangsu province. Since the National Bureau of Statistics adjusted the statistical calibre of year-end employment-population data from 2010, the data in 2009 and before were the sum of employed persons in urban units, privately and individually employed persons in urban units, and rural workers, and after 2010 were the population aged 16 and above in the resident population who were engaged in certain social labour or business activities and received labour compensation or business income. In addition, the logistics industry belongs to the category of tertiary industry, and according to the data, the number of employed persons in the tertiary industry accounted for about 45% of the year-end employment of the whole industry, which can represents the overall year-end employment of the whole industry. Therefore, in order to reduce the measurement error, this paper will use the number of employed persons in the tertiary industry at the end of the year instead of the number of employed persons in the whole industry at the end of the year, i.e., the improved locational entropy is the comparison of the ratio between the GDP of the logistics industry in Suzhou and the number of employed persons in the tertiary industry in Suzhou and the average value of Jiangsu province[7].

2.2 Indicators for measuring the level of urban economic development

Measuring the level of economic development of a city should be a complete index system, which includes human resources, financial revenue, GDP, environmental index, industrial structure, etc. GDP is the final result of the production activities of all resident units in a country or region in a specific period of time, and GDP, as the core index of national economic accounting, is also an important index to measure the level of economic development of a city. And due to the consideration of data authenticity and collectability, this paper will choose GDP as an indicator to measure the economic development of cities[8-9].

3. Empirical Analysis

3.1 Model setting

Based on previous studies on the impact of logistics industry agglomeration on the urban economy, this paper adopts the Cobb-Douglas production function as the basic analytical function to describe the impact of logistics industry agglomeration on the urban economy in Suzhou, with improved locational entropy as the core explanatory variable, and the specific function representation is shown in equation (2).

$$\mathrm{Y} = \mathrm{A}K^{\alpha}U^{\beta} \tag{2}$$

In this formula, Y represents the total economic output expressed as GDP, A represents the technology level, A is greater than 0 in general, K represents the physical capital input, α represents the output elasticity of physical capital input, $0 < \alpha < 1$, and U is the logistics industry agglomeration, β represents the output elasticity of logistics industry agglomeration, $0 < \beta < 1$. Since this paper considers the impact of logistics industry agglomeration on the urban economy in Suzhou, it is also necessary to logarithmize the above equation. Logarithmization does not change the correlation of the data and reduces the absolute value of the data to make it easier to calculate. Most importantly, the logarithmic treatment can alleviate the heteroskedasticity to ensure the usability of the model and further apply it to the quantitative analysis of the impact of Suzhou logistics industry agglomeration on the urban economy, so equation (2) is transformed as follows[10-12].

$$\ln GDP = \ln A + \alpha \ln K + \beta \ln U \tag{3}$$

It is assumed that the technology level of Suzhou city remains constant in the short term time and the variables that affect the level of economic development of the city according to the new economic growth theory are investment, consumption and export respectively. Therefore, in this paper, consumption (I) and export (E) is introduced into the basic analytical model together as explanatory variables, so equation (3) is transformed as follows.

$$\ln GDP_t = C + \alpha \ln K_t + \beta \ln U_t + \gamma \ln I_t + \delta \ln E_t + \varepsilon \tag{4}$$

In this formula, t denotes the year, C is a constant term, and ε is a random error term. α is the correlation coefficient between physical capital input and GDP, β is the correlation coefficient between improved locational entropy and GDP, γ is the correlation coefficient between consumption and GDP, and δ is the correlation coefficient between exports and GDP, and the correlation coefficient represents the degree of influence of this explanatory variable on GDP.

3.2 Explanation of variables

The variable data used in this paper were obtained from the Jiangsu Statistical Yearbook and Suzhou Statistical Yearbook from 2001 to 2020, and the variable data were analyzed and processed by Eviews 11.0. In equation (5), physical capital (K) is represented by the general public budget expenditure data of Suzhou city in calendar years, consumption (I) is represented by the disposable income data of urban residents in Suzhou city in calendar years, and export (E) is represented by the cargo volume data of Suzhou port outbound in calendar years, and the specific variable definition relationship is shown in Table 1.

Table 1: Variable definition relationships

Variables	**Indicators**	**Symbols**
Explained variables	Level of economic development of the city	GDP
Explanatory variables	Logistics industry agglomeration level	U
Control variables	Investment	K
	Consumption	I
	Export	E

Since the statistical yearbook data show that there is no clear indicator to represent the relevant data of the logistics industry as a whole for the time being, and the transportation, storage and postal industry is an important part of the logistics industry. Therefore, the improved locational entropy (U) is measured by using the data of transportation, storage and postal industry in Jiangsu Province and Suzhou City in the past years and the data of employment in tertiary industry at the end of the year, and the specific results are shown in Table 2.

Table 2: Indicators for measuring the entropy of the improved location of the logistics industry in Suzhou from 2001 to 2020

Year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Improved locational entropy	1.28	1.27	1.35	1.23	1.08	1.05	1.06	1.60	1.50	0.98
Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Improved locational entropy	0.95	0.92	0.94	0.93	1.03	1.03	1.04	1.01	1.02	1.07

From Table 2, it can be seen that during the twenty years from 2001 to 2020, the logistics industry agglomeration level in Suzhou is mostly higher than the overall logistics industry agglomeration level in Jiangsu Province, and the years with relatively low logistics industry agglomeration level indicate that the logistics development of that year cannot meet the logistics needs of that year. And the measured indexes show that the logistics industry agglomeration level in Suzhou is volatile, basically in a state of rising, then falling and then stabilizing.

3.3 Econometric analysis

3.3.1 Time series smoothness test

Because the variable data used in this paper are all time series data, pseudo-regression may occur due to the non-stationarity of the variable data, which may lead to invalid conclusions, and the Granger causality test presupposes that the variable data are stationary. Therefore, it is necessary to test the smoothness of each variable separately first. If the mean, variance and other parameters of the variables do not change over time, the time series can be considered as smooth. Of course, you can also pass the statistical test method, that is, the unit root test method. The unit root test is to test whether there is a unit root in the time series because the presence of a unit root is a non-stationary time series. The unit root test mainly includes the ADF test, NP test, GLS test, etc. The ADF test is developed by the extension of the DF test, which solves the situation that the DF test is only applicable to the first-order autoregression, so this paper will use the commonly used ADF test for the unit root test, that is, by comparing the ADF test value with the critical value at a certain significance level to determine whether the time series data are stable, the test results are shown in Table 3.

Table 3: ADF test results

Testing Variables	Testing Mode	ADF test values	1% threshold	5% threshold	10% threshold	P-value	Testing Conclusion
lnGDP	(C,T,0)	-1.079872	-4.532598	-3.673616	-3.277364	0.9060	Unstable
d(lnGDP)	(C,T,0)	-5.828946	-4.571559	-3.690814	-3.286909	0.0010	Stable
lnK	(C,T,2)	-2.652690	-4.616209	-3.710482	-3.297799	0.2647	Unstable
d(lnK)	(C,T,0)	-6.038052	-4.571559	-3.690814	-3.286909	0.0007	Stable
lnU	(C,T,1)	-3.466554	-4.571559	-3.690814	-3.286909	0.0739	Unstable
d(lnU)	(0,0,1)	-4.289511	-2.708094	-1.962813	-1.606129	0.0003	Stable
lnI	(C,0,0)	-1.922868	-3.831511	-3.029970	-2.655194	0.3155	Unstable
d(lnI)	(C,T,0)	-8.642899	-4.571559	-3.690814	-3.286909	0.0000	Stable
lnE	(0,0,1)	1.017220	-2.699769	-1.961409	-1.606610	0.9114	Unstable
d(lnE)	(C,T,3)	-5.396681	-4.728363	-3.759743	-3.324976	0.0034	Stable

As can be seen from Table 3, the time series lnGDP, lnK, lnU, and, and lnE are all non-stationary time series at a given 5% significance level, but their first-order difference series d(lnGDP), d(lnK), d(lnU), d(lnI), and d(lnE) are all stationary time series at a given 1% significance level. Therefore, the time series lnGDP, lnK, lnU, lnI, and lnE are all first-order single integer series, indicating that there is some stability among the variables. Figure 1 shows the trend diagram of the first-order difference of each variable data, their first-order difference series are all smooth and satisfy the precondition of the cointegration test, so this paper will further investigate whether they have a long-term synergistic relationship and conduct a cointegration test.

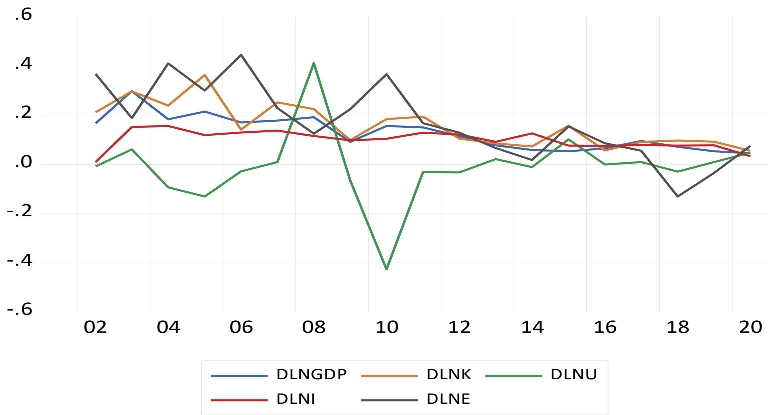

Figure 1: First-order differential trend of data for each variable

3.3.2 Constructing the VAR model

There are two main methods of cointegration tests, the EG cointegration test and the Johansen cointegration test. Since the EG cointegration test can only test the relationship between the explanatory variables and one explanatory variable, this paper will use the Johansen cointegration test which can perform multiple explanatory variables cointegration test.Because the Johansen cointegration test is tested on the basis of VAR model establishment, the lag order of the VAR model needs to be determined in this paper before conducting the cointegration test. Too large a lag order will lead to a reduction in the degrees of freedom of the parameters and affect the applicability of the parameter estimates. A small lag order will lead to the autocorrelation of the error term and affect the robustness of the parameter estimation. The optimal lag order is mainly judged by the information criteria of LR, AIC, and HQ, and the specific results are shown in Table 4.

Table 4: Optimal lag order judgement results

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	70.02383	NA	5.01E-10	-7.22487	-6.977544	-7.190767
1	179.3556	145.7758*	4.88E-14	-16.59507	-15.11112	-16.39045
2	226.2734	36.49157	1.01e-14*	-19.03038*	-16.30979*	-18.65524*

* represents the optimal lag order chosen by this information criterion. From Table 5, we can see that four of the five information criteria choose the second order as the optimal lag order, so the Johansen cointegration test should be performed at lag two, i.e., the VAR(2) model should be constructed immediately.

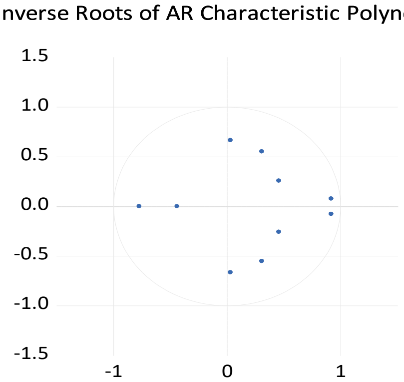

Figure 2: AR root diagram

The AR root plot is a test to observe whether the VAR (2) model has stability, and if the VAR model is unstable, it will lead to invalid results in the subsequent analysis. The points in the unit circle represent the mode of the AR characteristic root. From Figure 2, we can see that all the points fall in the unit circle, i.e., the mode of the AR characteristic root is less than 1, so the constructed VAR(2) model has stability and can continue the subsequent analysis.

3.3.3 Johansen co-integration test

Cointegration tests study the relationship between non-stationary series. If there is a cointegration relationship between non-stationary variables, there is some stable synergistic relationship between their changes in the long run. Although some variables themselves are non-stationary series, their linear combinations may be stationary series, and such linear combinations are called cointegrating equations, which can explain the long-term stable synergistic relationships among the variables, as shown in Tables 5 and 6.

Table 5: Results of the trace test

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.976092	131.9087	69.81889	0.0000
At most 1 *	0.872966	64.70515	47.85613	0.0006
At most 2	0.588961	27.56571	29.79707	0.0885
At most 3	0.399044	11.56249	15.49471	0.1791
At most 4	0.124646	2.396278	3.841465	0.1216

Note: * represents a rejection of the original hypothesis at a 5% significant level, ** represents the Mackinnon-Haug-Michelin (1999) p-value, same as in Table 6.

Table 6: Maximum characteristic root test results

Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.976092	67.20353	33.87687	0.0000
At most 1 *	0.872966	37.13944	27.58434	0.0022
At most 2	0.588961	16.00322	21.13162	0.2247
At most 3	0.399044	9.166210	14.26460	0.2726
At most 4	0.124646	2.396278	3.841465	0.1216

As can be seen from Tables 6 and 7, the trace test results and the maximum characteristic root test results show agreement at a given 5% significance level, both indicating the existence of two cointegration relationships among the five-time series of lnGDP, lnK, lnU, lnI, and lnE, resulting in the two cointegration equations normalized as shown in equations (5) and (6).

$$\ln GDP_{t-1} = 1.233713 \ln U_{t-1} + 0.982 \ln I_{t-1} - 0.16914 \ln E_{t-1} + 0.326011 \tag{5}$$

$$\ln K_{t-1} = 1.926283 \ln U_{t-1} + 1.614385 \ln I_{t-1} - 0.396794 \ln E_{t-1} + 2.594675 \tag{6}$$

The above cointegration equation shows that the changes among the variables have a stable synergistic relationship in the long run, and the improved location entropy of Suzhou, i.e., the level of Suzhou logistics industry concentration and Suzhou general public budget expenditure, are positively correlated with Suzhou GDP. The volume of goods leaving the port of Suzhou is negatively correlated with Suzhou's GDP, but the coefficient is tiny, indicating that Suzhou's GDP is in a weak trade deficit in the long run, i.e., the volume of goods entering the port is larger than the volume of goods leaving the port in a certain period, which indirectly explains why the median volume of goods entering the port of Suzhou is larger than the mean in the descriptive statistics of the variable data.

3.3.4 Granger causality test

Granger causality testing is a statistical hypothesis test that essentially determines whether a time series has predictive value for another time series. The principle is to introduce a lagged variable of one variable into the equation of the other variable and test whether it is influenced. If it is affected, it is said that there is a Granger causality between the two variables, which means that the two variables have predictive value for each other, and the test results are shown in Table 7.

Table 7: Results of Granger's causality test

Null Hypothesis	F-Statistic	Prob.
d(lnK) does not Granger Cause d(lnGDP)	0.07221	0.9307
d(lnGDP) does not Granger Cause d(lnK)	3.89974	0.0496
d(lnU) does not Granger Cause d(lnGDP)	5.50230	0.0201
d(lnGDP) does not Granger Cause d(lnU)	0.51719	0.6089
d(lnI) does not Granger Cause d(lnGDP)	4.68083	0.0471
d(lnGDP) does not Granger Cause d(lnI)	23.6788	0.0002
d(lnE) does not Granger Cause d(lnGDP)	15.9897	0.0012
d(lnGDP) does not Granger Cause d(lnE)	5.42677	0.0342

From Table 7, it can be seen that the disposable income of urban residents in Suzhou and the number of goods out of the port of Suzhou are the two-way Granger causality of GDP in Suzhou. That is, the change in disposable income of urban residents in Suzhou has a significant role in predicting Suzhou's GDP, and the change in Suzhou GDP also has a significant role in predicting the disposable income of urban residents in Suzhou, and the two-way Granger causality of the number of goods out of ports in Suzhou port and Suzhou GDP is also the same. Secondly, there is a one-way Granger causality between the level of concentration of the logistics industry in Suzhou and Suzhou's GDP, the change in the level of concentration of the logistics industry in Suzhou can affect the change of Suzhou's GDP, but the change of Suzhou GDP does not cause the change of the level of concentration of logistics industry in Suzhou, and at the same time, it means that the change of the level of concentration of industry in Suzhou can predict the change of Suzhou GDP to some extent. Similarly, there is a one-way Granger causality relationship between Suzhou GDP and Suzhou general public budget expenditure, and Suzhou GDP has a driving effect on Suzhou general public budget expenditure with a significant effect of predicted impact, while the effect of Suzhou general public budget expenditure on Suzhou GDP is not very significant.

3.3.5 Impulse response

Impulse response refers to the impact of applying a standard deviation shock to the variables in the VAR model based on the random error term, thus producing an impact in the current period and the future period, and the graph of impulse response relationship can visually show the dynamic characteristics of the VAR model. The impulse response is analyzed based on the results of the Granger causality test, and it is concluded from the results of the Granger causality test that there is a one-way Granger causality relationship between the agglomeration level of the logistics industry in Suzhou and the GDP of Suzhou city, so only a one-way impulse response relationship chart can be established to visually reflect the dynamic influence between the agglomeration level of the logistics industry and GDP of Suzhou city. In the impulse response relationship diagram, the horizontal axis indicates the number of lags after the effect of the shock, the vertical axis indicates the change of the shocked variable, the solid line in the middle indicates the impulse response function, and the two dashed lines at the top and bottom indicate the positive and negative two times standard deviation values, respectively. The level of agglomeration of the logistics industry in Suzhou is taken as the shock variable, and GDP of Suzhou is taken as the shock variable, and the time is set to 20 periods, and the specific results are shown in Figure 3.

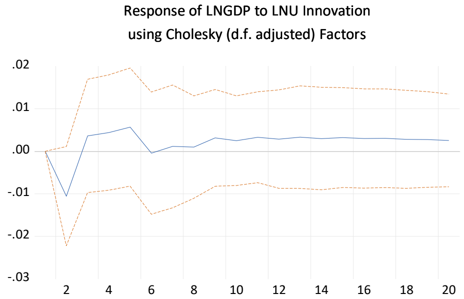

Figure 3: Impulse response relationship diagram

From Figure 3, it can be seen that when the level of Suzhou logistics industry agglomeration exerts a positive impact on Suzhou GDP in this period, the first two periods will have a negative impact on Suzhou GDP, indicating that at the initial stage of Suzhou logistics industry agglomeration is in the integration stage, and this stage does not form a good collaborative ability. From the second period to around the fifth period, Suzhou logistics industry agglomeration is at the peak climbing stage and continues to play a pulling role in Suzhou's GDP, indicating that this stage has experienced natural integration within the system and realized the effective use of resources and scale benefits. From around the fifth to the sixth period, Suzhou logistics industry agglomeration is in the retracement stage, after reaping the scale benefits, external enterprises gradually step in and break the short-term natural integration state. From the sixth period to the ninth period, the logistics industry agglomeration in Suzhou is in the oscillation stage along with innovation promotion, and the general trend is to drive the GDP of Suzhou upwards. Around the ninth period to the twentieth period, the promotion effect of the Suzhou logistics industry agglomeration on the GDP of Suzhou tends to level off, and the marginal benefit shows a small decreasing pattern.

3.3.6 Variance decomposition

The variance decomposition is to decompose the fluctuation of each variable in the VAR model and attribute the variance of each endogenous variable, and through the variance decomposition, the strength of the shock impact explanation of each variable can be clearly demonstrated. Therefore, in this paper, the variance decomposition will be performed for Suzhou GDP, and the time is set to 10 periods, and the specific results are shown in Table 8.

It can be seen that the explanatory strength of Suzhou logistics industry agglomeration level to Suzhou GDP reaches 21% in the second period. However, in the later stage, the explanation strength of Suzhou logistics industry agglomeration level to Suzhou GDP decreases with the growth of the period, which indicates that the marginal benefit of Suzhou logistics industry agglomeration is decreasing, and the explanation strength decreases to below 8%, and begins to show a small decreasing pattern and tends to level off. In the initial stage, Suzhou's GDP is mainly explained by itself. As time goes on, the explanatory strength of the port cargo volume out of Suzhou port generally shows an increasing trend. The general public budget expenditure of Suzhou city keeps decreasing in explanatory strength when it reaches the critical value. In the early stage, the explanatory strength of urban disposable income of Suzhou city moves inversely with the explanatory strength of Suzhou GDP itself, but when it reaches the equilibrium state, the explanatory strength of urban disposable income of Suzhou city moves in the same direction with the explanatory strength of Suzhou GDP itself.

Table 8: Results of variance decomposition

Variance Decomposition of lnGDP						
Period	**S.E.**	**lnGDP**	**lnK**	**lnU**	**lnI**	**lnE**
1	0.019883	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.022908	75.82230	0.000556	21.28657	2.204133	0.686439
3	0.026269	58.48983	9.062775	18.05414	5.158437	9.234823
4	0.033159	36.94727	30.83956	13.08474	12.02875	7.099679
5	0.037530	29.33038	35.01482	12.49951	14.34030	8.814984
6	0.041663	30.17391	33.28310	10.15406	16.60241	9.786514
7	0.045220	32.97516	29.51132	8.682167	16.95585	11.87550
8	0.047406	33.81319	28.17314	7.942435	17.38520	12.68603
9	0.049083	33.82068	27.50355	7.817308	17.12866	13.72980
10	0.050759	33.69345	27.65242	7.546350	16.87211	14.23566
Cholesky Ordering: lnGDP lnK lnU lnI lnE						

3.3.7 Building the VECM model

From the previous Johansen cointegration test, it is shown that there is a long-run equilibrium relationship between Suzhou GDP and Suzhou general public budget expenditure, Suzhou logistics industry agglomeration level, Suzhou urban residents' disposable income, and Suzhou port outbound port cargo volume. As we all know, the equilibrium state is non-constant, the constant state is non-equilibrium, and the long-term equilibrium relationship is maintained by the short-term dynamic relationship under the constant correction state. So the VECM model is created under the study of the short-run relationship of variables with the cointegration relationship between variables. Therefore, this paper establishes the regression equation of the VECM model on the basis of the cointegration equation, and the specific results are shown in equation (8).

$$\begin{aligned}\Delta \ln GDP = {} & 0.531961 VECM1_{t-1} - 0.860729 VECM2_{t-1} + 0.052554 \Delta \ln GDP_{t-1} \\ & -0.274625 \Delta \ln K_{t-1} - 0.126704 \Delta \ln U_{t-1} - 0.008623 \Delta \ln I_{t-1} \\ & -0.065114 \Delta \ln E_{t-1} + 0.175237 + e_t \end{aligned} \tag{7}$$

The error correction terms VECM1t-1 and VECM2t-2 indicate the deviation of Sioux City GDP from the long-run equilibrium in period t-1, and the coefficients are one positive and one negative, indicating the existence of positive and negative correction mechanisms. From equation (8), it can be seen that when the short-term Sioux City GDP deviates from the long-term equilibrium state in the positive direction, it will be adjusted at a correction rate of 0.860729 units, and when the short-term Sioux City GDP deviates from the long-term equilibrium state in the negative direction, it will be adjusted at a correction rate of 0.531961 units, thus further ensuring the return of each variable to the long-term equilibrium state.

4. Recommendations

Based on the findings of the above empirical analysis, it is found that the agglomeration of the logistics industry in Suzhou is an indispensable factor for the development of the city's economy, and the reasonable promotion of the agglomeration of the logistics industry can drive the development of the city's economy, so this paper makes the following suggestions.

First, for the logistics industry clusters with poor management mode and insufficient innovation power, the essential transformation buffer should be carried out through reorganization and integration and other modes to promote deep integration between the logistics industry and supporting industries. In the process of structural transformation, how to adjust the infrastructure and supporting facilities is the primary consideration, the Suzhou government can appropriately strengthen the support, rational allocation of resources and guide the agglomeration to avoid the waste of resources and high logistics costs and other problems.

Secondly, due to the fact that the scale benefits of logistics industry agglomeration are not constant and are gradually and steadily decreasing, Suzhou should pay attention to diversified development in the process of developing its urban economy. Using logistics industry agglomeration as an auxiliary force to promote urban economic development and pursuing a safe and stable development path. For the planned new logistics industry cluster, the government needs to pay more attention to planning site selection and actively improve the scarcity of cold chain and IT. For the planned new logistics industry cluster area, the government needs to pay more attention to planning and site selection, actively improve scarce systems such as cold chain and IT, in order to adapt to the efficient economic development of the entire city.

Thirdly, along with the continuous development of intelligent logistics, the Suzhou logistics industry cluster needs to continuously improve the level of intelligent logistics, so as to adapt to the fierce market competition, and the lack of logistics composite talents is also a major obstacle to the upgrading and transformation, Suzhou universities should actively build logistics specialities, pay attention to the docking cooperation with logistics enterprises, and train a group of logistics composite talents with solid theoretical foundation and excellent practical skills. In order to inject fresh blood into the logistics industry.

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