Study on Economic Growth Calculation Method Based in Big Data

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Abstract. In this study, firstly, the qualitative analysis of big data industry statistical classification system is carried out, and the idea of quantitative verification of big data industry statistical classification system is proposed, so as to determine a scientific and reasonable big data industry statistical classification system. Secondly, the input-output table of big data is compiled. Especially for the "non pure" big data industry sector size measurement. Finally, the contribution of big data industry to economic growth is deduced.

Keywords: big data, economic growth, calculation

In recent years, as an emerging industry that represents digital economic activities, the big data industry has sprung up and played an important role in promoting the transformation and development of my country's economy, and its contribution to economic growth has become the focus of attention. The contribution of the big data industry to economic growth is manifested in two aspects: first, the continuous expansion of industrial scale has increased the total national economy, and its direct contribution to economic growth; the second is the economic growth through optimizing the industrial structure of the national economy and endogenous technological progress. Indirect contribution to growth. The input-output table can quantitatively analyze the quantitative relationship between production and use among various sectors of the national economy, and has unique advantages in measuring industrial Economic Growths. It has been used by many scholars to measure the scale of emerging industries and industrial economic effects[1-5].

1. Big Data Industry Input-Output Table and Its Industrial Scale Measurement

The table design of the big data industry input-output table is based on the “China 2019 Input-Output Table”. The “China 2019 Input-Output Table” is a “full scale” table that includes the primary, secondary, and tertiary industries. 153 departments, the big data industry defined in this article are all included. Decompose the “China 2019 Input-Output Table” (153 sectors) into the “full-caliber” table according to the “quarter rule” and merge it into the primary industry, secondary industry, tertiary industry and big data industry. Big data industry is subdivided for 1, 2, 3, and 4 big data departments such as “big data production department”, “big data transmission organization management department”, “big data value service department” and “non-pure” big data industry department.
In order to compile the big data input-output table, a matrix algorithm based on the “full-caliber” input-output table proposed can be used. For this reason, it is necessary to calculate the proportion of the output value of the jth sector of big data input and output in the output value of the ith sector of the “full-caliber”, that is, the conversion coefficient, which is recorded as $P_{ij}$. Calculating the conversion coefficients for all sectors in the “full-caliber” you can get from “full-caliber” sector to $7 \times 7$ big data input-output Department's conversion factor matrix:

$$N = (N_{ij})$$  \hspace{1cm} (1)

$N_{ij}$ satisfies the following conditions.

1) $0 \leq P_{ij} \leq 1, i=1,2,\ldots,153, j=1,2,\ldots,7$.

2) The row sum of each row of matrix N is 1, that is $N_{ij} = 1, i=1,2,\ldots,153$.

3) $N_{ij} = 1$ for the “pure” big data industry sector ($L_j \geq 50$).

The key here is how to determine the $N_{ij}$ of the "impure" big data industry sector ($L_j < 50$)?

The first is sampling survey and typical survey methods. Select a number of units from the i sector, investigate their total output value and the output value of the big data industry, and use the ratio of the output value of the big data industry to the total output value as $N_{ij}$. Assuming that the labor productivity of each department is the same, that is, the labor productivity of workers engaged in big data is the same as the average labor productivity of the department, and the input composition of the output value of the big data industry is the same as that of the non-big data industry, then:

$$N_{ij} = \frac{H'}{H}$$  \hspace{1cm} (2)

1) $H' = $ Number of big data workers in departments

2) $H = $ Number of departmental workers

To apply this method, it must be assumed that the labor productivity of big data workers is the same as the labor productivity of all employees in their units, and that the input composition of big data output value is the same as that of non-big data output value. Obviously, such an assumption of the output value composition is unreasonable.

The second is the assumed distribution coefficient method. Assuming that the $N_{ij}$ of the “non-pure” big data industry sector ($L_j < 50$) is 50%, that is, for the non-pure big data industry sector that contains both big data and non-big data activities, according to the big data industry sector and the non-big data industry sector The average distribution of the industrial sector is 50% each. This method can simplify calculations, but this simple processing method can only be used for estimation, and the industrial scale obtained may not be accurate.

Based on the characteristics of the above two methods, combined with the total score $L_j$ of the big data industry feature identification of various industries proposed in the previous part, this paper determines the $N_{ij}$ of the “impure” big data industry sector ($L_j < 50$) as $L_j/50$.

After obtaining the conversion coefficient matrix P, the intermediate use data of the first quadrant of the “full-caliber” 153 $\times$ 153 department input-output table is marked as $L'$, the final use data of the second quadrant is marked as $J'$, and the initial input data of the third quadrant The matrix is denoted as $D'$. Record the intermediate use data in the first quadrant of the $7 \times 7$ big data input-output table as $L'$, the final use data in the second quadrant as $J'$, and the initial input data matrix in the third quadrant as $D'$. To convert the "full-caliber" input-output table into a big data input-output table, first perform row decomposition, then perform corresponding column decomposition, and finally merge the corresponding rows and columns:

$$L = N^t L' N, J = N^t J', D = D' N$$  \hspace{1cm} (3)

r is matrix transpose. From this, we can get the $7 \times 7$ big data industry input-output table .

According to the big data industry input-output table, the scale of the big data industry can be measured as follows.

1) Since the $N_{ij}$ of the “pure” big data industry sector ($L_j \geq 50$) is 1, therefore, industries that are defined as “pure” big data industry sectors can be separated from the “full-caliber” input-output table and their The output value is added to obtain the industrial scale of the big data production department, the big data transmission organization and management department, and the big data value service department, and the total can be the big data industry scale of the "pure" big data industry sector.
(2) “Improper” big data industry sector \((L_j<50)\) refers to the economic activities that use big data technology to transform and enhance the value of the industry in the main business. Its main business may belong to any industry in the national economy, such as agriculture, manufacturing, construction, finance, electric power, medical and health, storage, education, national administrative agencies, etc., the conversion coefficient \(N_{ij}\) of the “impure” big data industry sector can be multiplied by the output value of the corresponding industry to obtain the big data industry of the corresponding industry. The scale of activities can be summed up to get the total industrial scale of the “impure” big data industry sector.

2. Measurement of the Indirect Economic Growth of the Big Data Industry

In order to quantify the impact of the big data industry input on the national economy, through structural decomposition of the big data industry input-output model, the multiplier effect, feedback effect and spillover effect are obtained. The multiplier effect represents the change in the output level of the industry caused by the unit input in the big data industry, and is the impact of the industry’s own demand on its own output, expressed by \(W_i=1/(1-x_{ii})\); the feedback effect indicates the big data industry after the unit input has an impact on other industries, this impact will in turn have a feedback effect on the big data industry, expressed as \(L_i=y_{ij}-W_i\); the spillover effect can be defined as the direct impact of each unit of final demand in the big data industry on the output of other industries. The sum of the indirect effects and \(K_i=\sum y_{ii}\).

The contribution of the big data industry to economic growth is also reflected in the contribution to the economy in terms of production factors, economic structure, and organization and management. It can also be called the contribution of industrial technological progress to economic growth. The Leontief inverse coefficient matrix element of the input-output model includes direct consumption and indirect consumption determined by factors such as the technological situation in this period, and represents the complete consumption relationship between departments. Therefore, the contribution of technological progress of the big data industry sector to economic growth can be measured through the Leontief inverse coefficient matrix, but the premise is to establish a comparable big data industry input-output sequence table.

Using the compiled 2019 and 2013 big data industry input-output tables, excluding the influence of price factors, we get the 2019 and 2013 big data industry input-output tables with comparable prices. 2013 is the base period, and 2019 is the calculation period. The calculation is as follows:

\[
G = HO + V \quad (4)
\]

\[
G = (I-H)^{-1}V \quad (5)
\]

The Leontief inverse coefficient matrix is \((I-A)^{-1}\), denoted as \(U\), which is used to measure the technological progress of the big data industry. There are:

\[
G_t - G_0 = U_t V_t - U_0 V_0 = (U_t - U_0) V_0 + U_0(V_t - V_0) + (U_t - U_0)(V_t - V_0) \quad (6)
\]

where \(0\) and \(t\) represent the base period and calculation period respectively. Let \(\Delta G = G_t - G_0\), \(\Delta U = U_t - U_0\), \(\Delta V = V_t - V_0\), then

\[
\Delta G = (\Delta U)V_0 + U_0(\Delta V) + (\Delta U)(\Delta V) \quad (7)
\]

Equation (6) has two decomposition methods,

\[
\Delta G = (\Delta U)V_t + U_0(\Delta V) \quad (8)
\]

\[
\Delta G = (\Delta U)V_0 + U_t(\Delta V) \quad (9)
\]

According to the decomposition idea of a structural decomposition analysis model proposed by Li Jinghua (2005), the sum of equations (8) and (9) are calculated, and there are

\[
\Delta G = (\Delta U)(V_t - V_0)/2 + (\Delta V)(U_t - U_0)/2 \quad (10)
\]

Economic growth can be explained by two parts. One is the contribution of the technological progress of the big data industry to economic growth, and the other is the increase in total output driven by changes in the final product.

Therefore, the contribution rate of technological progress of the big data industry to economic growth is

\[
P = z'(\Delta U)z(\Delta G)(V_t - V_0)/2 \quad (11)
\]
3. Conclusion

This article explores the construction of the input-output table of the big data industry and the method of measuring Economic Growth. 2019 is the year of national input-output survey. In 2019, a preliminary “China 2019 Input-Output Table” will be produced. On this basis, the input-output table of the big data industry can be empirically analyzed and the Economic Growth of the big data industry can be made Measurement, this is of great significance for studying the interaction between the big data industry and non-big data industries that have emerged in recent years, predicting the development trend of the big data industry, and formulating the development strategy of the big data industry.

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z' represents a row vector with all 1 elements.