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Research on the Influencing Factors of Beijing's GDP

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Abstract:

This paper aims to discuss the factors affecting Beijing's GDP. The data of this paper comes from the Beijing Statistical Yearbook. By reviewing relevant literature, this paper selects five variables with the highest probability and uses the method of multiple linear regression to analyze these five variables in Beijing in 1999-2018. Considering that the variables will affect each other, this paper also adopts the stepwise regression method to solve the problem of multicollinearity. The final results show that import and export trade and the total retail sales of social commodities in Beijing have a significant impact on Beijing's GDP. In contrast, the total investment in fixed assets, resident population, and total energy consumption do not pass the significance test. In conclusion, Beijing's GDP is affected by import and export trade and total retail sales of social commodities in Beijing. Beijing should pay attention to the development of these two factors to further improve its economic strength and competitiveness.

Keywords: GDP; influencing factors; multiple linear regression; stepwise regression.

1. Introduction

Gross Domestic Product (GDP) has always been an economic indicator that people are more concerned about and attach importance to. GDP is the sum of the market value of all final goods and services produced within a country (or region) during a certain time [1]. GDP is a significant indicator in the study of a region‘s economic construction, development, and economic reform and has been called „one of the greatest inventions of the 21st century“ by a famous American economist, Samuelson [2]. GDP is expressed in three forms, namely, value form, income form, and product form. In terms of the value form, it is the difference between the value of all goods and services produced by all resident units in a given period over the value of all non-fixed-asset goods and services invested in the same period, i.e., the sum of the value added of all resident units. Regarding income patterns, it is the sum of the initial income distribution generated by all resident units and distributed to resident and non-resident units over a given time. In terms of product form, it is end-use goods and services minus imported goods and services. Therefore, GDP is important, and GDP can reflect the current economic situation of the country or city. GDP is affected by many factors, but the public is not aware of the influencing factors. Therefore, this paper will study the factors that influenced the GDP in Beijing from 1999 to 2018.

Beijing, as the core city of Beijing-Tianjin-Hebei synergistic development, Beijing‘s GDP has been growing year by year [3]. According to the data, the GDP of Beijing in 2022 was 4161.09 billion yuan [4]. Among them, the total economic output in the Haidian District of Beijing has exceeded one trillion yuan, reaching 1.02069 trillion yuan, becoming the second district in China with a GDP of over one trillion dollars [5].

Therefore, what factors have enabled Beijing‘s GDP to grow steadily yearly and reach such a high value? Here are some of the possible influencing factors: Guo used the ADF unit root test, cointegration test, ECM error correction model, and Granger causality test to conclude that there is a long-run equilibrium relationship between the investment in social fixed assets and GDP in Beijing [6]. Zhao and Qin pointed out that there is a cointegration relationship between GDP and total energy consumption in Beijing [7]. Shao et al. concluded that Beijing‘s resident population has a significant effect on Beijing‘s GDP by building a regression model [8]. The model established by Joe eliminated multicollinearity, heteroskedasticity, and serial correlation and had a good fit, thus analyzing the impact of import and export trade on Beijing‘s GDP [9]. Wang believed that the correlation between Beijing‘s total social consumption of goods and Beijing‘s GDP is high [10]. These are several factors that may affect Beijing‘s GDP.

This paper focuses on five variables (Beijing‘s total investment in fixed assets, import and export trade, resident population, Beijing‘s total social retail sales, Beijing‘s total energy consumption) to determine their impacts on Beijing‘s GDP and to further select an appropriate model

to study the impacts of these factors on Beijing‘s GDP. To summarize, this paper will use a multiple linear regression model to study the impact of these five factors on Beijing‘s GDP.

2. Methods

2.1 Data Source

The data used in this paper are from the Beijing Statistical Yearbook. All data are from 1999-2018, and these data have seven samples with a sample size of 140. As all data used in this paper come from the Beijing Statistical Yearbook, these data are authoritative, and they have not been lost, so they have not been deleted.

2.2 Variable Introduction

The data contain five independent variables (Beijing‘s total investment in fixed assets, import and export trade volume, Beijing‘s resident population, Beijing‘s total retail sales of consumer goods, and Beijing‘s total energy consumption) and one dependent variable (GDP). Under the above conditions, let Y be the dependent variable, representing Beijing‘s GDP; let X1, X2, X3, X4, and X5 represent Beijing‘s total investment in fixed assets, import and export trade volume, Beijing‘s resident population, Beijing‘s total retail sales of consumer goods and Beijing‘s total energy consumption, respectively. These specific data descriptions are shown in Table 1:

Table 1. Variable scale

Variable	Symbol	Meaning
Investment in social fixed assets	X1	Beijing social fixed asset investment
Import and export trade	X2	Total value of import and export trade
Resident population	X3	Beijing resident population
Total retail sales of consumer goods	X4	Total retail sales of consumer goods in Beijing
Total energy consumption	X5	Total energy consumption in Beijing
GDP	Y	Gross Domestic Product

2.3 Method Introduction

This paper will use multiple linear regression to analyze these factors, judge whether these variables will affect the dependent variables according to the five variables selected, and find out which are important factors. A multiple linear regression model is a linear regression model with multiple explanatory variables. The basic principle is to find the minimum value of the sum of squares of residuals according to the definition of the least square method. The general equation for multiple linear regression is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu \quad (1)$$

Where is the constant term and is the residual term.

3. Results and Discussion

3.1 Description Analysis

The following shows the GDP data of Beijing from 1999 to 2018 and the data of possible influencing factors, as shown in Figures 1, 2, and 3. Figure 1 shows Beijing‘s GDP from 1999 to 2018 and its growth rate, which can be seen from the data that Beijing‘s GDP has been growing during this time.

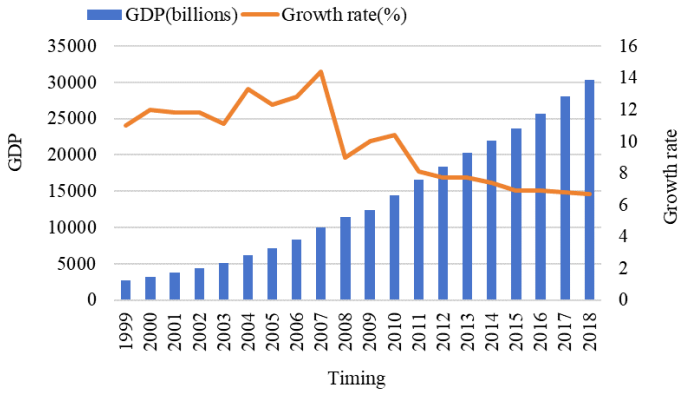

Fig. 1 Beijing‘s GDP and growth rates from 1999 to 2018

Figure 2 shows Beijing‘s import and export trade, total retail sales of consumer goods, and investment in fixed assets from 1999 to 2018.

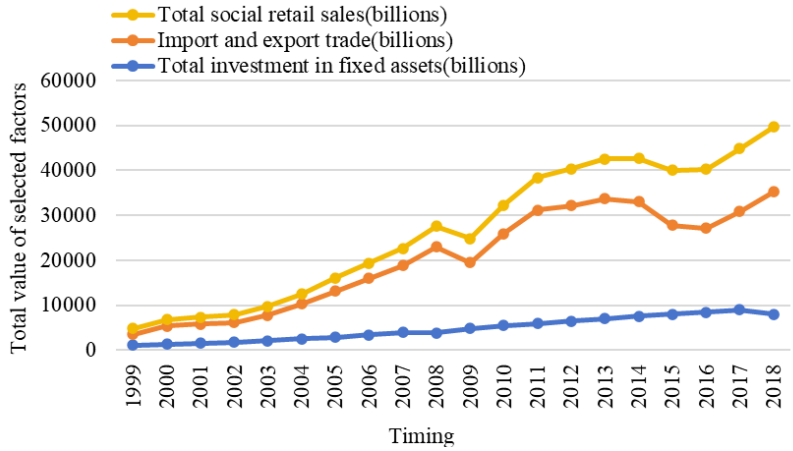

Fig. 2 Total value of selected factors in Beijing from 1999 to 2018

Figure 3 shows the resident population of Beijing and the total energy consumption of Beijing from 1999 to 2018.

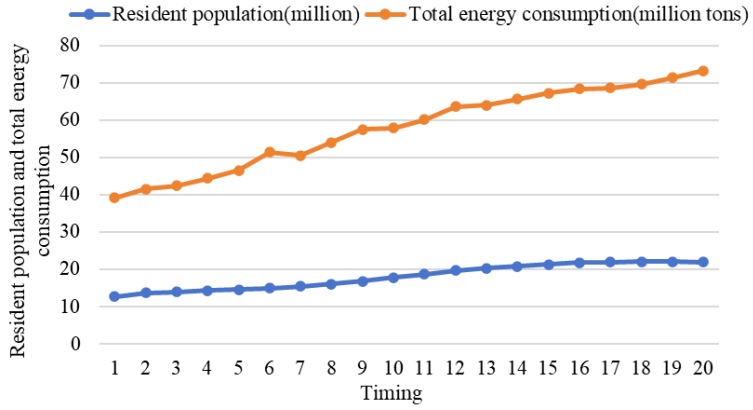

Fig. 3 Beijing‘s resident population and total energy consumption from 1999 to 2018

3.2 Correlation Analysis

In this paper, the correlation between the above five factors is first analyzed, considering that they may affect each other. The Pearson coefficients between these five factors are shown in Figure 4 below:

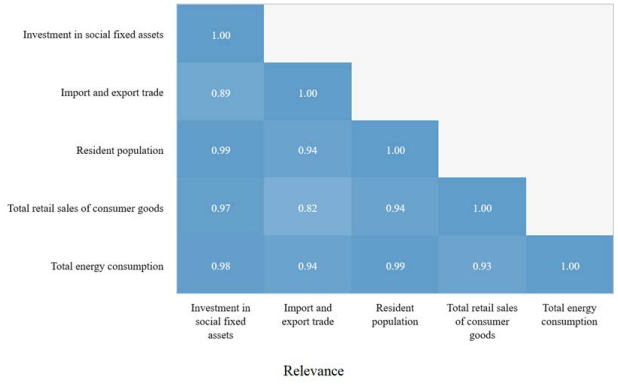

Fig. 4 Pearson correlation coefficient

The above figure illustrates the strong correlation between these five factors, indicating that there may be multicollinearity between these five factors. Thus, this paper uses multiple linear regression to determine whether there is multicollinearity by observing their VIF values. In this paper, the above data were standardized to obtain a table of results of linear regression analysis, as shown in Table 2 below.

The data in Table 2 show that import and export trade and total retail sales of consumer goods have a positive and significant effect on Beijing‘s GDP, and note that the regression coefficient value of the resident population is negative, which indicates that this independent variable is negatively related to the dependent variable. The VIF values of all independent variables are greater than 5, which means that they have multicollinearity, so this paper will use the stepwise regression method to eliminate multicollinearity.

Table 2. Regression coefficient results

	B	S.E.	Beta	T	P	VIF	Tolerance
Constant	0.011	0.011	-	1.012	0.329	-	-
X1	0.079	0.135	0.084	0.587	0.566	152.93	0.007
X2	0.166	0.044	0.179	3.805	0.002**	16.655	0.06
X3	-0.192	0.108	-0.213	-1.779	0.097	108.682	0.009
X4	0.774	0.058	0.826	13.444	0.000**	28.502	0.035
X5	0.152	0.078	0.152	1.943	0.072	46.227	0.022

Note: ** denotes p less than 0.01, which shows a significant effect.

3.3 Elimination of Multicollinearity

Multicollinearity refers to the distortion or difficulty in estimating accurately the model due to the presence of exact correlations or high correlations between the explanatory variables in a linear regression model. Generally, the limitations of economic data make the model improperly designed, resulting in pervasive correlations among the explanatory variables in the design matrix.

Due to the multicollinearity in the above five factors, this paper will use stepwise regression to eliminate the multicollinearity. After using stepwise regression in this paper, the results are shown in Table 3:

Table 3. Stepwise regression analysis results

	B	S.E.	Beta	T	P	VIF	Tolerance
Constant	0.014	0.007	-	1.814	0.087	-	-
X2	0.164	0.02	0.177	8.143	0.000**	2.993	0.334
X4	0.796	0.02	0.849	39.035	0.000**	2.993	0.334

Note: ** denotes p less than 0.01, which shows a significant effect.

After stepwise regression, the VIF values of the two remaining variables are less than 5, indicating that the problem of multicollinearity has been solved. The p-values of both variables are less than 0.01, and their regression coefficient values are positive, indicating that both variables have a positive and significant effect on the dependent variable. At this point, the model passed the F-test with an R^2 value of 0.997 and an adjusted value of 0.997, indicating that this is a better model. Therefore, the final model is obtained in this paper, and its regression equation is:

$$Y = 0.014 + 0.164X_2 + 0.796X_4 \quad (2)$$

4. Conclusion

This paper obtains data from the Beijing Statistical Yearbook and analyzes the factors that influenced Beijing‘s GDP from 1999 to 2018 through multiple linear regression and stepwise regression. The findings show that import and export trade and total retail sales of social consumer goods have a significant positive impact on Beijing‘s GDP. In contrast, the impact of social fixed asset investment, resident population, and total energy consumption on Beijing‘s GDP is not significant. Summarizing the above, the following insights can be drawn:

Firstly, economic growth does not only depend on the domestic market but also needs to be driven by foreign trade. Import and export trade is an important force driving economic growth and can provide new opportunities and impetus for economic development.

Secondly, the growth of total retail sales of consumer goods in Beijing also makes an important contribution to economic growth. Consumption is an important driving force for economic growth. By meeting the diversified consumption needs of the residents, it can promote the growth of domestic demand and boost economic development.

Thirdly, Beijing should strengthen its research and analysis on import and export trade and social consumption to understand their impact and influence on economic growth. This will help the government better grasp the trends and laws of economic development, formulate reasonable economic policies, and promote sustainable economic development.

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