Statistical Analysis of the Structure of Total Petroleum Consumption in China

Zhe Wang
Fuzhou University of International Studies and Trade, Fuzhou 350202, Fujian, China

Abstract. The essay firstly analyzes the present condition and the structure of the total petroleum consumption in China. Then, the method of qualitative analysis will be applied to conduct research on main essences that affects the total petroleum consumption in China to select ten indexes from acquired relevant statistics and lay out a comprehensive constitution of the total petroleum consumption in China. Subsequently, constructs a multivariate linear regression model for these ten indexes by means of quantitative analysis, and utilizes the spss software to conduct research on these influential essences. Last but not the least, the future situation of China's petroleum energy consumption will be forecasted and relevant countermeasures and suggestions will be put forward based on outcomes of empirical analysis.

1. Introduction
Petroleum is a kind of indispensable energy resources that has reached to each and every aspects of people's lives. About forty years after the Reform and Opening-up, there have been distinctive changes in economic structure, level of urbanization and national consumption structure. Countries around the globe will have an increasingly large demand on petroleum with the soaring development of world economy. There are four main affecting factors in petroleum demand: economic situation and development level, oil price, technical level of the oil industry and the impact of national policies. From the total consumption of petroleum energy, it increased from 24.959 million tons in 2000 to 59.52 million tons in 2017. As a matter of fact, the consumption of petroleum in China will continue to increase with the enhancement of China’s economy. Hence, forecast and analysis of China's future petroleum consumption is of great significance to determine China's future dependence on foreign petroleum and to formulate a long-term national petroleum strategic plan.

At this present period of time, scenario analysis and energy consumption elasticity coefficient method are commonly used in oil energy consumption prediction, but these methods have large prediction errors. In the prediction of energy consumption structure, more combinatorial models are used, such as prediction methods based on the Bayesian theory. Markov model is of invalid after effect, and can further optimize the energy consumption structure. While BP neural network model can improve the accuracy and efficiency of total forecast, and the error is smaller. The multiple regression statistical analysis method is applied in this essay to conduct analysis and forecast on the total petroleum consumption and the consumption structure in China, to offer basis for realizing the rationalization of petroleum consumption structure and to provide data support for decision makers to optimize the overall planning of petroleum consumption and carry through economic restructuring.
2. Illustration of Sample Data
According to the research of this essay, what Table 1 shows is the reported annual statistics of total petroleum consumption in China from 2000 to 2017, which stems from China Energy Statistics Yearbook.

| Year   | Total Consumption of Petroleum (Y) | Total Consumption of Petroleum in Agriculture, Forestry, Animal Husbandry, Fishery, Water Conservancy Industry (X1) | Total Consumption of Petroleum in Industry (X2) | Total Consumption of Petroleum in Construction (X3) | Total Consumption of Petroleum in Transportation, Storage and Postal Service (X4) | Total Consumption of Petroleum in other Industries (X5) |
|--------|-----------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------|
| 2017   | 59,500.20                         | 2,200.30                                                                                                   | 2,916.90                                      | 13,153.70                                       | 42,691.60                                                               | 4,080.20                                      |
| 2016   | 57,890.40                         | 1,950.60                                                                                                   | 2,353.80                                      | 11,027.50                                       | 34,360.80                                                               | 3,514.60                                      |
| 2015   | 56,235.80                         | 1,890.50                                                                                                   | 2,521.80                                      | 9,549.60                                        | 29,016.90                                                               | 3,469.50                                      |
| 2014   | 52,760.60                         | 1,756.20                                                                                                   | 2,345.10                                      | 7,916.70                                        | 21,284.40                                                               | 3,747.10                                      |
| 2013   | 50,890.80                         | 1,628.80                                                                                                   | 1,823.10                                      | 3,062.10                                        | 18,148.80                                                               | 3,488.20                                      |
| 2012   | 47,650.50                         | 1,537.90                                                                                                   | 17,673.00                                     | 2,699.10                                        | 17,838.60                                                               | 3,067.80                                      |
| 2011   | 45,378.50                         | 1,466.30                                                                                                   | 18,005.00                                     | 2,521.80                                        | 16,021.00                                                               | 2,880.50                                      |
| 2010   | 43,245.20                         | 1,382.50                                                                                                   | 18,148.40                                     | 2,345.10                                        | 14,870.30                                                               | 2,556.70                                      |
| 2009   | 38,384.50                         | 1,308.10                                                                                                   | 15,692.90                                     | 1,942.30                                        | 13,548.50                                                               | 2,296.30                                      |
| 2008   | 37,302.90                         | 1,265.80                                                                                                   | 15,603.10                                     | 1,517.50                                        | 13,279.40                                                               | 2,353.80                                      |
| 2007   | 36,658.70                         | 1,399.90                                                                                                   | 14,905.10                                     | 1,823.10                                        | 12,906.70                                                               | 2,215.90                                      |
| 2006   | 34,876.20                         | 1,540.20                                                                                                   | 14,804.30                                     | 1,648.50                                        | 10,709.50                                                               | 1,969.20                                      |
| 2005   | 32,537.70                         | 1,451.70                                                                                                   | 14,968.80                                     | 1,392.30                                        | 9,549.60                                                                | 2,001.70                                      |
| 2004   | 31,700.50                         | 1,231.40                                                                                                   | 13,196.50                                     | 1,190.60                                        | 7,916.70                                                                | 1,756.40                                      |
| 2003   | 27,125.80                         | 922.4                                                                                                      | 12,309.40                                     | 1,046.60                                        | 7,041.70                                                                | 1,698.60                                      |
| 2002   | 24,789.20                         | 838.6                                                                                                      | 11,227.20                                     | 933.8                                           | 6,587.90                                                                | 1,673.70                                      |
| 2001   | 22,888.40                         | 788.5                                                                                                      | 11,248.50                                     | 840.6                                           | 6,399.00                                                                | 1,635.90                                      |
| 2000   | 22,495.90                         | 788.5                                                                                                      | 11,248.50                                     | 840.6                                           | 6,399.00                                                                | 1,635.90                                      |

Note: Total petroleum energy consumption is expressed by Y, and other independent variables are expressed respectively by X1, X2, X3, X4, X5, X6, X7, X8, X9 and X10.
3. The Structure of Total Petroleum Consumption in China
In 2016, China's total oil consumption reached 579 million tons, an increase of 3.0% year on year, and a compound growth rate of 5.5% in 2005-2015. In terms of China's economic development, owing to the uniqueness of China's economic system and the relationship between China's economic structure, total petroleum consumption in China mainly consists of the total petroleum consumption in agriculture, forestry, animal husbandry, fishery, and water conservancy industry (10 thousand ton), total consumption of petroleum in industry (10 thousand ton), total consumption of petroleum in construction (10 thousand ton), total consumption of petroleum in transportation, storage, and mail service (10 thousand ton), total consumption of petroleum in other industries (10 thousand ton), total living consumption of petroleum (10 thousand ton), industrial terminal consumption of petroleum (10 thousand ton), intermediate consumption (for processing conversion) (10 thousand ton), and loss of petroleum refining (10 thousand ton). Take the year of 2017 as an example, in the composition distribution of total petroleum consumption in China, transportation, storage and mail service petroleum consumption accounted for the largest proportion, which is about 71.75%, followed by the construction industry, and the third largest proportion was industrial terminal consumption.

4. Case Study

4.1. Establishment of Multivariate Regression Model
Construct analysis model of multiple regression: \( Y = \alpha_i + \beta_i X_i \) (i=1,2,...,6), in which Y represents the total consumption of petroleum in China, Xi is the first influential essence, \( \alpha_i \) and \( \beta_i \) are parameters to be estimated. The outcome of analysis model by spss software is manifested as the following:

\[
Y = 2127.978 + 12.516X_1 + 2.750X_4 + 18254.436X_6
\]

| Table 2. Regression Coefficient |
|---------------------------------|----------------|----------------|-------|--------|--------|
| Variable | Unstandardized Coefficient | Standard Error | Standardization Coefficient | t     | Significance | Collinearity Statistics |
|----------|----------------------------|----------------|-----------------------------|-------|-------------|------------------------|
| Content  | 7.838                      | 88.718         | 2.005                       | 0.080 |             |                        |
| X1       | 2.090                      | 6.059          | 1.033                       | 3.050 | 0.009       | 0.010                  | 5.926                  |
| X2       | 1.153                      | 0.844          | 1.075                       | 2.398 | 0.037       | 0.005                  | 2.056                  |
| X3       | 0.487                      | 3.699          | 0.112                       | 0.132 | 0.098       | 0.004                  | 3.454                  |
| X4       | 0.467                      | 0.353          | 0.294                       | 3.844 | 0.000       | 0.015                  | 6.297                  |
| X5       | -0.035                     | 0.163          | -0.007                      | -2.212| 0.000       | 0.326                  | 2.149                  |
| X6       | -0.768                     | 0.401          | -0.168                      | -1.917| 0.092       | 0.364                  | 2.748                  |
| X7       | 0.713                      | 0.253          | 0.794                       | 3.844 | 0.000       | 0.015                  | 6.297                  |
| X8       | -0.015                     | 0.134          | -0.017                      | -4.212| 0.010       | 0.426                  | 2.349                  |
| X9       | -0.068                     | 0.560          | -0.341                      | -1.047| 0.032       | 0.504                  | 2.740                  |
| X10      | 0.467                      | 0.344          | 1.305                       | 1.490 | 0.037       | 0.045                  | 3.067                  |

Based on Table 2, the t-test statistic value of independent variable X1 is 3.050, the significance level is 0.009, which is less than the critical value 0.05, passes the t-test and enters the model. The t-test statistic value of independent variable X 2 is 2.398, the significance level is 0.037, which is less than the critical value 0.05, passes the t-test and enters the model. The t-test statistic value of independent variable X4 is 3.844, the significance level is 0.000, which is less than the critical value 0.05, passes the t-test and enters the model. The t-test statistic value of independent variable X4 is -4.212, the significance level is 0.000, which is less than the critical value 0.05, passes the t-test and enters the model. However, the t-test statistic value of independent variable X3 is 0.132, the significance level is 0.098, which is greater than the critical value 0.05, does not pass the t-test and does not enter the model. The t-test statistic value of independent variable X6 is -1.917, the significance level is 0.092, which is greater than the critical value 0.05, does not pass the t-test and
does not enter the model. The statistic value of constant t-test is 2.005, the significance level is 0.080, which is greater than the critical value 0.05, does not pass the t-test and does not enter the model. The VIF value is less than the critical value 10, which indicates that there is no multiple collinearity. In this way, the final multiple regression model is as the following:

\[ Y = 2.090X_1 + 1.153X_2 + 0.467X_4 - 0.035X_5 \]

4.2. Result Analysis of Multivariate Regression Model

**Table 3. Abstract of Model**

| Model | R | R-th Power | Adjusted R-th Power | Errors in Standard Estimation | Change Statistics | Durbin-Watson |
|-------|---|------------|---------------------|-----------------------------|------------------|---------------|
|       |   |            |                     | Variation of R-th Power | F Variation | Variance 1 | Variance 2 | Quantity of Significance |
| 1     | .989a | .978 | .961 | .100834007000000 | .978 | 58.326 | 6 | 8 | .000 | 2.100 |

In terms of Table 3, \( R^2 = 0.978 \) in the model, the value of adjusted \( R^2 \) is 0.961, which is close to 1 and means that linear relation is notable. The value of D-W is 2.100, which is close to 2 and means that autocorrelation does not exist.

**Table 4. Regression Model**

| Model    | Quadratic Sum | Variance | Mean Square | F     | Significance |
|----------|---------------|----------|-------------|-------|--------------|
| Regression | 3.558 | 6 | .593 | 58.326 | .000b |
| Residual  | .081 | 8 | .010 |       |              |
| Grand Total | 3.640 | 14 |       |       |              |

Based on the above Table 4, the test statistical value of regression model F is 58.326. The value of p is 0.000, which is lower than critical value 0.05. After the examination of F, the regression model is notable.

5. Conclusion

There are various kinds of factors endowing influences on the total petroleum consumption in China. The essay applies qualitative analysis to probe into traits and influencing factors of the total petroleum consumption in China. And the conclusion is obtained that as for the structure of the total petroleum consumption in China, total petroleum consumption in transportation, storage, mail service takes up the largest proportion—71.75%, while petroleum consumption in construction is secondary, and the proportion of industrial terminal ranks the third. The multiple linear regression model is utilized in this essay to analyse the relationship between the total petroleum energy consumption and the influencing factors in the structure of petroleum energy consumption in China. Stemmed from the empirical analysis results, it acquires the possible problems in the total petroleum energy consumption in China, and puts forward relevant suggestions for the development of petroleum energy and economic structure in China.

Based on the positive analysis above the conclusion could be reached that the total petroleum consumption in China is mostly affected by variations related to total petroleum consumption in agriculture, forestry, animal husbandry, fishery, water conservancy industry, total consumption of petroleum in transportation, storage, and mail service, total consumption of petroleum in industry and total consumption of petroleum in other industries. In other words, total petroleum consumption in transportation, storage, and mail service, total petroleum consumption in agriculture, forestry, animal
husbandry, fishery, water conservancy industry, total consumption of petroleum in industry and total consumption of petroleum in other industries are directly related with the total petroleum consumption in China. Besides, with the reform and transformation of Chinese economy structure, the demand on the amount of petroleum in service industries like transportation and storage is intensively increasing, and with the mechanization of agriculture and modernization, the demand on the amount of petroleum in fields like agriculture, forestry, animal husbandry, fishery, and water conservancy is soaringly expanding.

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