An Analysis of the Influencing Factors of Carbon Dioxide Emissions -- Base on the Consumption Choice

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Abstract. In the process of economic construction, the development of the economy will have an impact on the environment, whether it is good or bad. This paper selects carbon dioxide emissions as an indicator of environmental quality. And the population in each period of each country, the per capita electricity consumption of each country, the proportion of coal, oil and natural gas power generation in each period of each country, the ratio of education expenditure to GDP in each country, the ratio of forest area in each country to the national area, and the price of gasoline in each period of country as six explanatory variables. The empirical analysis of the above variables yields conclusions that the economic development will have a negative impact on the environment and give relevant recommendations.

Keywords: Carbon Dioxide Emissions, Economic Externality, Energy Conservation and Emission Reduction

1. Introduction

Environment is the basis of human survival and the important guarantee of social sustainable development. In the 1860s, the excessive "overdraft" of the environment in the process of industrialization in developed countries forced countries to rethink the transformation and innovation of economic development mode, so as to achieve sustainable economic growth at the lowest possible cost of resources and environment. The report of the 18th National Congress of the Communist Party of China puts forward that "we should integrate resource consumption, environmental damage and ecological benefits into the evaluation system of economic and social development, and establish the target system, assessment method and reward and punishment mechanism that reflect the requirements of ecological civilization"[1]. For developing countries, we need to deal with the coordinated development between environment and economic and social development with more innovative thinking, so as to create ecological culture. The new era of Ming development [2].

Many scholars at home and abroad have made researches on the relationship between environment and economy, and discussed the factors affecting environment. In the previous research, this paper re selects samples and explanatory variables, discusses the relationship between environment and economy with different explanatory variables, attempts to empirically analyze the mechanism of the interaction between environment and economic externalities, finds out the factors that have an important impact on the environment, and provides reasonable suggestions for China's environmental governance.
2. Literature Review
Domestic scholars have unified support opinions on whether China wants to implement the development mode of low-carbon economy. Hu CONGYANG (2008) pointed out that several countries that China can learn from when considering economic benefits and environmental reasons for development, including Britain, Sweden and other European countries, but due to the differences in economic development mode and current situation, the most worthy of learning is Japan’s experience[3]. Yu Yang (2014) studied China’s net carbon dioxide emissions and driving factors based on the relationship between spatial pattern and decoupling, and found that energy intensity, per capita GDP, population, forest and green area all had a greater impact on carbon dioxide emissions [4].

Sami chaabouni, kais saidI (2017) investigated the causal relationship between carbon dioxide emissions, health spending and GDP growth in 51 countries (divided into low-income countries, low-income countries and middle-income countries) [5].Natael demek and gebremariam (2016), taking Ethiopia as an example, used the STIRPAT model and the autoregressive distribution lag (ARDL) to analyze the country in 1971-In 2011, the impact of population growth, per capita GDP and technological improvement on its carbon dioxide emissions was found that the high growth of population in Ethiopia had the greatest impact on carbon dioxide emissions: in the long run, 1% population growth would lead to 1.42% increase in carbon dioxide emissions; different from economic theory, in statistics, per capita GDP had a significant impact on carbon dioxide emissions of the country. It doesn’t matter [6].

3. Empirical Analysis of Carbon Dioxide Emissions and Influencing Factors
3.1 Variable Selection
(1) Explained variable: carbon dioxide emissions
In this paper, carbon dioxide emissions as a measure of the quality of the environment, it is generally believed that countries with low carbon dioxide emissions have a good environment.

(2) Explanatory variables: population, per capita electricity consumption, coal, oil and gas power generation, education expenditure, forest area and gasoline price.

The first three variables are a description of a country’s overall energy consumption capacity. Education expenditure and the proportion of forest area are variables reflecting a country’s awareness of environmental protection. People who have higher education should have a stronger sense of environmental protection. At the same time, forest coverage also reflects the degree of environmental protection of people in a country. Gasoline price is a representative product to increase carbon dioxide emissions (and has no direct relationship with electric energy). Its price will affect its market usage, thus affecting carbon dioxide emissions.

![Figure 1](impact of environmental awareness)

![Figure 2](impact of environmental product price)

Figure 1 impact of environmental awareness  Figure 2 impact of environmental product price
X1 stands for environmental protection products (carbon dioxide will not be emitted in the process of use, such as solar energy), X2 vice versa. When the awareness of environmental protection is enhanced, people’s preference for environmental protection products is enhanced [7]. In Figure 1, the dotted
line represents the indifference curve in the case of strong environmental awareness. When the same utility is obtained, more environmental protection products will be consumed when the environmental protection awareness is strong, that is, Q0 is less than Q1. Similarly, when the price of environmental protection products drops, the consumption of environmental protection products will increase (as shown in Figure 2), that is, Q0 is less than Q1. The effect of falling gasoline prices is the opposite [8].

In view of the main task of this paper is to investigate the influence of geographical factors, energy structure and utilization on a country’s carbon dioxide emissions and to explore China’s carbon dioxide governance and construction strategy. Therefore, in terms of the selection of variables, there is no comprehensive investigation on all the factors that affect the emissions. Instead, the six variables that have a significant impact on carbon dioxide emissions are selected, and other factors are put together in the residual item. This paper attempts to take GDP into account in the model to show the correlation between a country’s economic level and carbon dioxide, but it has a serious correlation with the proportion of education, which can not be tested, so this variable is abandoned.

All the data used in this paper are from the world bank database.

3.2. Sample Selection
The samples selected in this paper are the top 10 countries in the world, and the total carbon dioxide emissions exceed 50% of the global share - China, the United States, India, Japan, Germany, Canada, the Republic of Korea, the Islamic Republic of Iran, the United Kingdom, Mexico [9]. The time period is 2000-2014. The main reason for choosing this time period is that after entering the 21st century, the economic development of all countries is rapid, the international economic environment is stable, and the data is comparable. From the scope of the sample, it includes not only the countries with large land area and population, but also the countries with relatively small global area. At the same time, it also considers the more economic development, including developed countries and developing countries. In terms of data selection characteristics, both national level data and time level data are considered.

3.3. Model Building
Based on the research on the impact of population and power energy use on carbon dioxide emissions [9], this paper constructs an expanded research model. Among them, the influencing factors of expansion include education level, national attention to environmental protection and gasoline use. The basic form of the model is as follows:

\[ \ln \text{DISCHARGE}_{it} = \mu + \alpha_1 \ln \text{POP}_{it} + \alpha_2 \ln \text{PC}_{it} + \alpha_3 \text{PR}_{it} + \alpha_4 \text{EDU}_{it} + \alpha_5 \text{FOR}_{it} + \alpha_6 \text{P}_{it} + \varepsilon_{it} \]

Discharge it represents the carbon dioxide emissions of each country in each period; popit represents the population of each country in each period; PCIT represents the per capita power consumption of each country in each period, reflecting the level of national energy consumption; prior represents the proportion of coal, oil and natural gas power generation in each period, reflecting the energy structure; eduit represents the proportion of education expenditure in GDP in each period, reflecting the investment of future scientific and technological talents by the country; fortit represents the proportion of forest area in each period, reflecting the greening and environmental protection of a country Degree; pit represents the price of gasoline in each period of each country, reflecting the traffic situation [10].

3.4. Analysis of Empirical Results
The regression results of the model show that: through the F test, there are variables in the model that will have a significant impact on carbon dioxide emissions; the adjusted R2 is very close to 1, indicating that the overall fitting validity of the model is very good.

It can be seen from table 1 that the three factors of population, per capita electricity consumption and the proportion of coal, oil and natural gas power generation have a positive correlation with the carbon dioxide emissions, and the influence degree is very large, which is consistent with the expectation; the proportion of education expenditure to GDP, the proportion of forest area to the national area, and the
negative correlation between the gasoline price and carbon dioxide emissions in each period, and the influence degree is very small, also with the prediction The period coincide [11].

Table 1 Basic regression results

| Coefficient | Std.Error | T Statistic | Prob. | VIF  |
|-------------|-----------|-------------|-------|------|
| C (intercept) | -10.921 | 0.222 | -49.218 | 0.000 | 2.409 |
| POP         | 0.946    | 0.008     | 117.621 | 0.000 | 2.557 |
| PC          | 0.854    | 0.010     | 86.385  | 0.000 | 1.870 |
| PR          | 0.694    | 0.048     | 14.541  | 0.000 | 1.986 |
| EDU         | -0.066   | 0.000     | -7.486  | 0.000 | 1.633 |
| FOR         | -0.005   | 0.013     | -12.090 | 0.000 | 1.202 |
| P           | -0.215   | 0.013     | -16.133 | 0.000 | 1.202 |

R-squared 0.997 Adjusted R-squared 0.994
F-statistic 3873.269 Prob.(F-statistic) 0.000

3.5 Model Test
1. Heteroscedasticity test

![Residual diagram](image)

Figure 3 Residual diagram

From the residual diagram, we can preliminarily judge that the model has the problem of heteroscedasticity, which may lead to the failure of the test results. In order to check the heteroscedasticity of the model more accurately, BP test and white test are carried out in this paper (see Table 2). Through the test, it is found that the p value is less than 0.01, and the model does have heteroscedasticity.

Table 2 Heteroscedasticity test

| BP test            | White Test                |
|--------------------|---------------------------|
| Chi2(6)=21.53 Prob>chi2=0.0015 | Chi2(27)=88.27 Prob>chi2=0.0000 |

In order to eliminate the influence of heteroscedasticity on the research results, WLS, the most widely used data model, is adopted in this paper. The corrected results are shown in Table 3. The absolute value of the influence coefficient of EDU on carbon dioxide emission increased from 0.066 to 0.0798, which indicates that after the effect of heteroscedasticity is eliminated, the impact of
environmental awareness formed by education on carbon dioxide emission is increased. It can be seen that WLS improves efficiency.

Table 3 Model correction regression

| Regression variable (Indischarge) | (1)    | (2)    |
|----------------------------------|--------|--------|
| POP                              | 0.623*** | 0.947*** |
|                                  | (0.0402) | (0.00781) |
| PC                               | 0.877*** |        |
|                                  | (0.00829) |        |
| PR                               | 0.731*** |        |
|                                  | (0.0550)  |        |
| EDU                              | -0.0798*** |        |
|                                  | (0.00788) |        |
| FOR                              | -0.00599*** |        |
|                                  | (0.000440) |        |
| P                                | -0.201*** |        |
|                                  | (0.0140)  |        |
| Constant                         | 2.156*** | -11.09*** |
|                                  | (0.757)  | (0.217) |
| R-squared                        | 0.618   | 0.995   |

4. Conclusion

4.1 Research Conclusion
In this paper, by consulting relevant data and conducting empirical research, the sample is selected as the top 10 countries in the world, to investigate the impact of population and power energy use on carbon dioxide emissions in the 14 years 2000-2014.

Through regression analysis, we can find that population; electricity consumption per capita and the proportion of coal, oil and natural gas power generation have a positive correlation with carbon dioxide emissions, and have a great impact. These three indicators are closely related to production and consumption, and they will have a significant positive correlation impact on carbon dioxide emissions. Energy consumption per capita reflects the level of national energy consumption, and energy use is an effective indicator to measure a country's economic development level. The higher the economic level of the country, the more carbon dioxide it will emit, the greater the impact on the environment, economic development to the environment is not good. This result reflects that with the continuous growth of production and consumption, pollution will continue to grow. It can be said that the environmental problems are largely due to the external diseconomy of production and consumption - negative externality.

4.2 Enlightenment
Both positive and negative externalities will affect the optimal allocation of environmental resources and bring more serious environmental problems. Therefore, in order to reduce the negative impact of economic development on the environment, it is necessary to effectively internalize the externality of the environment, that is to say, the external costs generated by producers and consumers should be included in their production and consumption decisions, and they should bear the losses caused by externality, at the same time, reduce the costs borne by environmental protectors in environmental protection and reduce the losses [12].

However, under the influence of incomplete information, it is difficult for all the players in the market to reach the most efficient decision-making in some cases. Obviously, the pure market mechanism can not effectively guide the main body to produce solutions [13]. Therefore, the
government needs to use appropriate means to take a series of measures and policies to intervene, so that they can make the right choice and realize the harmonious development of economy and environment.

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