

Limit Line Policy the Short-term Impact Study of Chongqing Urban Air Quality

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Abstract

In recent years, more and more serious congestion and environmental problems. Beginning in 2008, Beijing, China for the first time use of motor vehicles. The limit line policy, then the measures of different degree of restrictions taken in different places. Because chongqing landform is unique, therefore its policy restrictions have high research value. This article is based on the terrain characteristics of chongqing and the present situation of traffic, using a single differential method to evaluate the implementation of the policy have a short-term impact on the quality of the weather, the implementation of the data show that different from other cities, limit line policy of chongqing urban air quality has a certain role in promoting, but the effect is not obvious. At the same time, the policy did not cause the second increase in private car purchase behavior.

Keywords

Limit Line Policy; Air Quality Index; Influence; Chongqing Urban.

1. Introduction

According to the carbon network, in 2020, China's carbon emissions is 10 billion tons, accounting for about 29 of the global carbon emissions requirements clearly in the national "much starker choices-and graver consequences-in planning in our country to be completed by 2020 per unit of GDP carbon emissions than 2005 forty percent international commitments low-carbon targets, the chemical oxygen demand (cod), ammonia nitrogen, sulfur dioxide, nitrogen oxide emissions control respectively in 20.01 million tons, 2.07 million tons, 15.8 million tons, 15.74 million tons. High carbon intensity field are mainly concentrated in the transportation industry in the tertiary industry, automobile changed the world, also brought many social diseases, traffic congestion, environmental pollution has become a juxtaposed with relatively poor, and health problems such as the "city disease" [1]. From table 1, according to the Ministry of Public Security traffic management bureau information at the end of 2020, chongqing has 5.045 million vehicles, an increase of 41.1 growth rate among the various provinces and cities first, personal car increased to 513400 units, 12.4 of civilian vehicles 49.9 3 in chongqing due to terrain, trams penetration rate is not high also[2]. The increase of car ownership has brought traffic congestion and pollution weather even more of a challenge. Automobile exhaust has been recognized as the biggest culprit is the air pollution, pollution caused by the main pollutant is pm10, fine particulate matter.

Chongqing is an industrial city, with the rapid economic development in chongqing, the urban construction scale expands unceasingly, the increasing of car ownership, the increasingly prominent problem of atmospheric pollution in chongqing urban area, 2012, chongqing in the 47 key environmental protection cities in the country ranked fifth. Chongqing in 2021 to join the army of limited number, according to the chongqing radio and television reported 1 eye, chongqing in 2021 air quality days 326 days, the best has 146 days (rose 11 days), does not appear heavy pollution days, the macro view, chongqing's air quality has been effectively

improved, from the environment to discuss the effect of motor vehicle limit line policy in chongqing, the research of motor vehicle limit line policy impact on air quality, has important theoretical significance and practical value.

Limit line policy originated in Buenos Aires[3]. Began in August 2007, Beijing motor vehicle tail restrictions measures, up to now, there are 7 big cities implement tail, because of the economic, geographical environment, different cities, different implementation strategies, also have different effects, including guizhou, chengdu effect is significant[4]. Domestic and foreign scholars have long started to limit policy research, mainly including policy of residents travel choice, the effects of traffic congestion, air quality. Abroad, scholars have adopted a variety of methods of motor vehicle limit line policy on atmospheric environment were analyzed. Hochstetler andKcck (2004) by establishing the model to estimate vehicle limit line policy evaluation of Sao Paulo 19 can effectively reduce the motor vehicle emissions. Lucas WDavis drew Mexico (2008) through the measure of a limit line policy implementation has no obvious effect on the improvement of the air quality in[5]. Rodrigo Troncoso and restrictions (2012) established a weekend day in Santiago, Chile, the multiple regression model to analysis the vehicle limit line policy impact on air quality, it is found that the policy to improve air quality has played a positive role in[7]. Domestically, hong-xia sun the OLS regression and double difference method is adopted to Beijing implemented limit number policy impact on air quality to do the research, it is concluded that short term policy number can be to have the significant effect to improve air quality, long-term effects. Liang Yongxian with CMAQ model to study the effect of the policy of shenzhen ozone concentration. Liu Yonghong used COPERT model to evaluate the limit line policy can effectively reduce exhaust emissions[8].

To sum up, the object of study mainly on the quality of the weather is wide on north of the city is given priority to, the research methods mainly for the linear regression model. In general, the limit line policy on the improvement of the quality of weather there is good in the short run, in the long term, it brings adverse effects. With the current research object is different, chongqing is located in the sichuan basin, is a more rugged; Rivers, rich water, humidity is big, and flat terrain, such as Beijing, chengdu temperate monsoon climate, the water sources are insufficient. At the same time, chongqing mountainous foggy, so the study of mountainous terrain of chongqing with innovative research value.

2. Limit Line Policy

2.1. Policy Background

As the rise of a Midwestern cities, the growth of chengdu-chongqing economic circle, and "spirited away", "light rail wear floor" and other attractions ones, more and more people came to live in chongqing tourism, traffic growth is too fast, environmental problems are becoming more and more serious. Chongqing city built on a mountain, is the two great river separates, landscape division made chongqing unique spatial patterns, formed a typical "multicenter, author" urban structure, between different regions is mainly connected by Bridges and tunnels [2]. Bridges and tunnels generally lower speed limit, traffic capacity is limited, interweave area number, mixed serious conflict. The labor-intensive industry, the residents live in area of a city, is the formation of congestion point, which is associated with air pollution problems. According to the main air quality report in 2019, although the shapingba district with gele mountain forest park, but the worst air quality, ranked first, which is closely connected with travel traffic depended. Secondly, jiulongpo district, have multiple forest park, jiulongpo district, such as white city yi park, highland yun, but based on the situation as a gathering place of the old industrial base and residents have, its ranking still poor. According to data released the sanitation station in January 2015, chongqing serious pollution, the air quality index, 262 AQI in 329. Pollution in chongqing are distributed in 1, 2, 10, in December, which is especially

obvious in January, in recent years, chongqing did a lot of efforts to improve air quality, while in severe pollution, few days, but the moderate pollution and pollution still occupy a larger proportion. If not controlled, with an increase in the number of cars, the future is likely to be returned to the state before the governance. On March 1, 2021 - February 28, 2022, chongqing in the weekday morning rush 7:00-9:00-7:30 and late peak 17:00 hours for all chongqing cadastral cadastral plate and the chongqing automobile adopted a policy of peak traffic bridge sui, a total of 4.5 hours a day. According to the chongqing local treasure, March 1, 2022, increasing restrictions bridge and tunnel as follows, double stone bridge (two-way) and double stone tunnel (bidirectional), the university city tunnel (two-way), liangshan in tunnel (two-way). Restrictions: Monday tail number 1, 6 restrictions; Tuesday tail number 2, 7, Wednesday tail number 3, 8 restrictions; On Thursday, tail number 4, 9 restrictions; Tail number 5, 0 restrictions on Friday. With Beijing, Shanghai and other places restrictions policy is different, tunnels is the connection between area, group channel, every day there are about 56 percent vehicles through the nodes, chongqing is the peak travel of tunnels for the terrain, economic characteristics unique to limit line policy.

2.2. AQI Changes

Compared with 2019, 2020, 2021, three years of air quality index can be preliminary, 2021 air quality index obviously widespread distribution in 30 to 50, dark areas in figure 5 to 2019 air quality index, you can see, 2019 AQI index mainly concentrated in the region of the 50 to 60.

Can preliminary inference, limit line policy make the air quality has improved, through the analysis of the relevant departments of the report, the improvement of air quality in chongqing CO, PM2.5 emissions has been effectively controlled.

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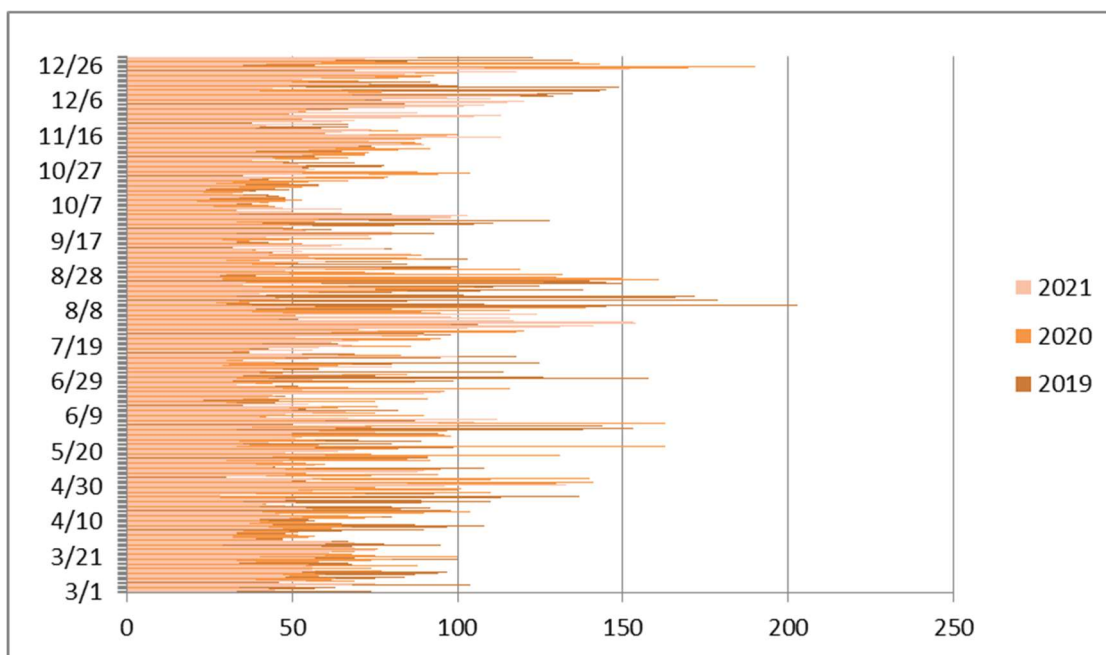


Figure 1. In 2019-2021 AQI changes

2.3. Increase in Motor Vehicles

Table 1. Chongqing car production increase in monthly

month	2020	grwth	2021	grwth
1-2	9.8	-54.9%	33.2	48.1%
3	11	-31.6%	16.3	27.4
4	13.5	14.7%	17.2	2.1%
5	13.9	63.6%	14.2	4.7%
6	14.7	48.9%	15.4	23.7%
7	11.8	21.8%	14.6	39.8%
8	11.3	34.7%	15.8	15.1%
9	15.2	35.8%	17.5	19.1%
10	15.2	33.9%	18.1	-
11	17.4	22.0%	-	-
12	17.4	22.0%	-	-

After the previous policy imposed restrictions are often accompanied by private car sales rose to offset policy affect travel characteristics, according to the National Bureau of Statistics bulletin of the national economy and social development since finishing in chongqing imposed restrictions policy increase in number of vehicles. In 2021 in chongqing by the year 1.998 million the cumulative production ranking fifth in the country. In 2021, according to data of chongqing industrial enterprises above designated size car production in October 181000, year-on-year growth of 18.7 percent, growth is 15.2 percent lower than the same period last year, growth is slowing, growth rate is 27% higher than the same period. From table 2 chongqing automobile production of monthly table as you can see, 1 to 2, 2020 car production fell by 54.9 percent march fell 31.6 percent analysis reason mainly is the 2020 epidemic situation is relatively serious, affecting the development of the industries, back in 2021. Limit number began in March 2021, can be found in March year-on-year growth of 48.1percent October 4 - though still keep growth trend, but overall, in the same period growth rate decreases. Thus, no limit policy on has imposed under the background of more than a year, and no obvious influence on the number of motor vehicles has increased.

3. Model Building and Regression

A complete process of public policy, including the early stage of the policy of data investigation, also includes the policy after implementation to evaluate the effect of the policy, to make sure the correctness of the implementation of policy and value.

Any a transport policy implementation should be tracking and evaluation system.

With one difference method, this paper use the weather indexes before and after the policy implementation, air quality, the working day of the week did the short-term studies.

3.1. Data Sources and Variable Selection

Be explained variable, this article USES the air quality index of AQI is as explained variable, air quality reflects the degree of air pollution, it is judged based on the pollutant concentration in air, air quality, and the good index of judging including SO₂, NO₂ and PM₁₀ and PM_{2.5}, O₃, CO and other six pollutants. The smaller the AQI, air condition, the better. This article USES the data of environmental monitoring station for chongqing public release of the air quality index, data collection time is ffrom March 1, 2019, 2020, 2021 to March 31, 2022. Explanatory variables: in order to increase the accuracy of the model, based on the chongqing summer temperature is high, the characteristics of the humidity is big, all the year round in this paper, in addition to

selection policy variables, temperature, humidity, wind speed is also chosen as the explained variable.

3.2. Model Specification

In order to explore the limit line policy for the improvement of air quality in chongqing the short-term effects of the following model:

$$AQI_i = \alpha + \beta_1AQI_{i-1} + \beta_2policy + \beta_3humid + \beta_4temp + \beta_5weekend + +\beta_6month + \varepsilon_i \quad (1)$$

Type, the AQI is daily air quality index and air pollution in the day and the day before or two days before there is a certain relationship, therefore has chosen the I phase lag issue that I - 1 AQI value to reduce the error brought by lag. M on behalf of humid, temp - temperature - humidity, generally speaking, the greater the humidity, wind speed, the conference directly influence PM2.5, AQI is lower, the better air quality; The higher the temperature, based on the airflow effect, can cause pollutants diffusion stronger, air quality becomes poor. The Policy for Policy virtual variables, the values of 0, 1. Not implemented policies take 0, the limit line policy after 1. Fusion indicates whether or not the day of the virtual variables, value of 0, 1, the value is 0 on behalf of the weekday, values for and on behalf of the working day.

3.3. Regression Results

Clean sanitation station released in December 2020 and March 2021 - chongqing public release of air quality parameters, using the state software regression analysis was carried out on the model, data are smooth, gradually add variables, regression results are obtained as follows.

Table 2. Regression results

variable	(1)	(2)	(3)	(4)
AQI_{i-1}	0.6192292*** (0.055)	0.6181842*** (0.055)	0.611164*** (0.055)	0.6059926*** (0.054)
policy	0.0351887*** (4.27)	0.0354113*** (4.30)	0.0200241* (1.78)	0.0344885*** (2.72)
humid	-0.0071004*** (-7.6)	-0.007187*** (-7.65)	-0.0078816*** (-6.11)	-0.0071723*** (-5.48)
temp	-	-0.004362*** (-3.55)	-0.003355** (-2.04)	-0.002203* (-2.73)
weekend	-	-	0.033247 (1.52)	0.0136391** (1.84)
month	-	-	-	-0.0599*** (-2.77)
Date adjustment	YES	YES	YES	YES
Sample size	921	921	921	921

In return, the focus on policy, the influence of humidity, temperature, holidays and in, can be seen from the table, and other control variables, the more restrictions policy have an impact on air quality coefficient significantly stronger; Humidity, temperature and air quality index is inversely proportional to, comply with the expected results; Due to the holiday, not imposed restrictions policy over the weekend, will be introduced in data variables over the weekend, after regression shows has influence to the AQI, but the effect was not significant; At the same

time, considering the seasonal influence on air quality index is introduced in model (4) the month this side variable, regression shows that in the air quality index of chongqing.

4. Conclusion

To sum up, in this paper, using the environmental monitoring station open air quality index, establish regression model, explores the chongqing of the limit of bridge traffic policies have a short-term impact on the environment. We learn that in the macroscopic statistical bridge, tunnel in chongqing urban shall limit line policy, air quality days 326 days, the best has 146 days (rose 11 days), does not appear heavy pollution days. But can be seen from the regression results, although the limit line policy variables on AQI index had an impact, but the effect is not obvious, this shows that limit line policy in the short term to improve air quality. At the same time, the limit line policy is not to buy the second has a great influence on the behavior of the private car. Analysis may have the following reasons: the first is to limit line policy time is shorter, restricted area and is mainly a bridge, tunnel, caused the compared with other areas of the limit line policy after, chongqing's air quality was not because of the limit line policy has great changes. The second is that the data is relatively limited. AQI pollutant monitoring for 6 items, limit line policy may has a great influence on a kind of pollutants, but the results after using the unified change may appear. Third, according to data nearly five years of automobile industry, China auto market appeared weak, automobile production volume in a decline in nearly two years, and the outbreak of the large area of the new champions league in 2020, various industries are affected by the massive, outbreaks of transportation chain has had an impact, increasing the error. Fourth, technically, although chongqing further increased the dust pollution control and related enterprises, open burning, straw burning, smoked bacon, fireworks and other controls, but the air pollution caused by many factors, automobile exhaust is one of the sources of pollution. With the speeding up of urbanization process, the air pollution in the growing trend, restrictions brought by the policy could be offset the effect of improving air quality. Fifth, from the subjective choice, people's travel behaviour change to offset the effects of this policy. People may choose to travel time or date in unlimited ways to increase, as well as in unlimited ways of driving, even avoid lines Bridges and tunnels and take further driving.

According to the result of model calculation, the limit line policy, there is no significant effect on the improvement of the quality of weather. Compared to Singapore, Hong Kong, two cities terrain characteristics similar to chongqing, population density is big, "multicenter, author" travel as well as the significant geographical economic features; And Singapore, Hong Kong annual average air quality index of 24 respectively, 30, chongqing air quality index is about 54 on average, differ with Singapore nearly doubled. Comprehensive analysis of the reason, give the following Suggestions: first, to perfect the public transport system, guide people to take more cheap public transport, alleviate traffic pressure at the same time, further improve the air quality of chongqing. Chongqing homogeneity serious bus system the existing lines, rail transport and road transport system repeat rate is high, want to be fundamentally solved from traffic congestion and air quality problems, unlimited expansion of highway is obviously not feasible, promote and improve the public transport system is the inevitable choice; Second, intensify policy support for public transport, the enforcement of chongqing to encourage public transport policy with morning and evening rush hour bus first, and in this paper, the author studies on limit line policy, the foreign will through economic means to change the route of the vehicle, such as "owning a car pass" pricing, increase the car taxes and other measures. Chongqing existing bus need to take the first step and business policy, at the same time also need to supplement policy measures to boost the public transport system according to actual condition, power environmental improvement.

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