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Evaluation on the Effect of Car Use Restriction Measures in Beijing

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Abstract

Recent years, with the rapid growth of car ownership in Beijing, urban transportation service level, air quality and energy consumption are facing great challenge. However, it is difficult to implement the measure of car use restriction because of all kinds of reasons. By taking chance of the 29th Olympic Games, Beijing municipal authority implemented the temporary measure of car use based on odd and even-numbered license plate. Then, after the 29th Olympic Games, Beijing municipal authority issued the measure of drive one day less a week on October, 11th 2008 to continue restricting car use.

We collected transportation data about road travel speed, public transport operation, air quality and residents' response from Oct. 2007 to Feb. 2009 period to evaluate the implementation effect of these car use restriction measures. The evaluation results show that these car use restriction measures have achieved fairly good effects on improving urban transportation and air quality. But the effects of current car use restriction measure are being counteracted by continually rapid growth of car ownership and use. Based on the analysis of the developing trend of Beijing transportation, we propose some recommendations for future integrated car use restriction measures in Beijing.

1. INTRODUCTION

Increased environmental and social costs of vehicle use, especially private car use, such as congestion, noise, air pollution, and depletion of energy are likely future consequences of the worldwide increasing trend in car ownership and use (Goodwin, 1996; Greene and Wegener, 1997; Sperling, 1995). In Beijing these consequences are in fact already urgent problems that need to be solved (Li et al., 2004; Quan et al., 2007; Mao, 2008).

In the past two decades, Beijing is at a rapid motorization period. Car total amount of Beijing has increased from 0.6 million in 1986 year to 3.4 million before 29th Olympic game, on average with 21% increasing rate per year. By August 2009, the car amount is 3.8 million, and is still increasing by 1 thousand vehicles everyday (Liu and Guo, 2009).

Moreover, Beijing daily traffic volume has increased by 190% from less than 9 million passengers in 1986 to more than 26 million passengers in 2008, meanwhile average trip distance has increased from 6 kilometer per passenger to 9.3 kilometer per passenger at the same period.

Car travel share of the total traffic has rapidly increased from 5% in 1986 to 32% in 2008, however in the same time bus share just increased from 28% to 36.8%.

In Beijing, car traffic occupies 77% capacity of the road network. Road construction cannot increase at a rate to match the growth of car traffic demand. Transportation congestion and air pollution is getting worse consequently. Car rapid growth and excess use is one of the key reasons that cause Beijing transportation congestion. Therefore, it is necessary to restrict car ownership and use (Garling et al., 2002; Loukopoulos et al., 2006).

In the past, Chinese government hesitated to place permanent limits on car ownership and use because automobile industry plays an important role in national economy development. But the Beijing Olympic Games offered the opportunity of implementing the car use restriction measures.

2. CAR USE BASED ON ODD AND EVEN-NUMBERED LICENSE PLATE DURING BEIJING OLYMPIC GAMES

In order to guarantee Beijing transportation and air quality during 29th Olympic Games, Beijing municipal issued a series of TDM measures, mainly including car use based on odd and even-numbered license plate.

In this paper, we evaluate the effect of the car use restriction measure from several aspects, such as road traffic volume, car travel speed, numbers of accidents, and travel modal split etc, see Table 1.

Table 1 Impacts of car use based on odd and even-numbered license plates

Category	Effect	Category	Effect
Traffic volume	↓22.5%	Bus	13.14 million passengers per day
Average speed on road network	30.2km/h (↑6.7km/h)	Railway transport	3.95 million passengers per day (↑45.5%)
Accidents that reported to police	↓53.1%	Taxi	2.22 million passengers per day (↑18%)
		Travel proportion	Public transport share more than 45%

2.1 Traffic Efficiency

As shown in Table 1, when the measure implemented, road traffic volume reduced 22.5% compared with that of pre-Olympics, and average car travel speed in morning peek of working days reached 30.2km/h, increased by 6.7km/h compared with that of pre-Olympics, and the numbers of accident reduced 53.1%.

2.2 Travel Modal Split

As for car-owning passengers, 50% of them shifted to public transport for traveling. Public transport carried 19.3 million passengers each day on average, most of the transport demand during the Olympics. There among, bus carried 13.14 million passengers, subway 3.95 million passengers, and taxi 2.22 million passengers. The passenger amount of subway and of taxi increased 45% and 18% respectively compared with the period without car use restriction (Wang et al., 2008).

Public transport -- including bus and subway – shared 45% of the total traffic during the 29th Olympic Games, 10 points higher than that of pre-Olympics.

2.3 Public Response

Beijing residents were generally thrilled by the results of the measure of car use based on odd and even-numbered license plate. 93% interviewees felt that transportation was more safety and rapid than before, and 50% interviewees felt that the service level of bus and subway had improved, and even 74% interviewees suggested that some measures of the green drive should be implemented permanently (BTRC, 2008).

2.4 General Comments on Car Use Based On Odd And Even-numbered License Plate

The measure of car use based on odd and even-numbered license plate was implemented under the special period of Beijing Olympic Games; therefore it easily obtained supports from all kinds of people. For example, its approval rating among car-owning people was as high as to 88.3%.

Short-term car use based on odd and even-numbered license plates produced good effect, but the measure is not suitable for long-term implementation because of its side effects (e.g., provoking some people to buy a second car, causing some factories burdening economic losses). But the application of TDM measures during Beijing Olympic Games promoted the wide acceptance of car use restriction measures, and developed a public basis for future car use restriction measures' implementation.

3. DRIVE ONE DAY LESS A WEEK IN POST-OLYMPICS TIME

During the Olympics, Beijing implemented a series of TDM measures. Chief among them are car use based on odd and even-numbered license plates, which took 2 million vehicles off roads for two months during the Olympics and Paralympics. As a result, road traffic volume reduced, accidents reduced, motor emission reduced, and road travel speed enhanced on the whole. The country's leaders and Beijing residents were thrilled with the results of the green drive, and ordinary folks have appealed to keep some measures in place.

In Oct., 2008, Beijing municipal authority drew up the measure of drive one day less a week after carefully considered the scheme's effectivity, operability and societal acceptance. The same as before, the vehicles that exceed emission standards are still prohibited to drive within 5th Ring Road.

The measure of drive one day less a week has implemented nearly one year by now. We collected transport data from Oct. 2007 to Feb. 2009 period to evaluate the effect of the

measure of drive one day less a week. The data ranges over road network transport data, public transport operation data, air quality data and residents' response data etc.

In the following, we evaluate the measure of drive one day less a week according to the 4 aspects: road transport, passenger transport, air quality and societal responses.

3.1 Evaluation on Road Transportation

We select data from October 2007 to Nev. 2007 as basic data of non restriction of car use, and data from July 20th 2008 to September 20th 2008 as basic data of car use based on odd and even-numbered license plates, and data from October 11th 2008 to Feb. 10th 2009 as basic data of drive one day less a week. Comparing with travel speeds and road traffic volumes in different periods, we evaluate the effect of the measure of drive one day less a week.

Table 2 Average speed of all levels of roads within 5th Ring Road, Beijing (Working Day, Unit: km/h)

	Morning Peak (7:00-9:00)			Evening Peak (17:00-19:00)		
	Non Restriction	Odd-even Number	Drive One Day Less a Week	Non Restriction	Odd-even Numbers	Drive One Day Less a Week
Express Way	31.1	41.6	37.7	25.4	37.8	31.2
Trunk Road	20.9	27.8	23.8	18.1	24.1	20.1
Branch road	18.2	23.8	20.6	16.1	21.3	17.8
Road network	21.8	28.9	25.2	18.7	25.6	21.3

*Data source: Beijing Municipal Committee of Transport

Compared with non restriction period, road travel speed was markedly improved during the period of drive one day less a week, which increased by 3.4km/h (15.6%) in morning peek time and 2.6km/h (13.8%) in evening peek time. See Table 2. On the average, traffic volume on trunk roads reduced by 4.1%, and travel speed on trunk roads increase by 5.5% in working days.

3.2 Evaluation on Passenger Transport

After the measure of drive one day less a week came into force in October 2008, public transport passenger volume had increased to 17.47 million passengers per day on the average in first three weeks, increasing by 0.94 million passengers per day (6%) compare with the period from July 1st to July 19th, 2008. In February, 2009, public transport daily volume reached 18.74 million passengers, among which, on average bus carried 13.43 million passengers and railway carried 3.53 million passengers.

According to investigation, bus travel speed is higher 5% than that of 2007 on the average.

During November 2008, on average, taxi total hired time was 243 hours, and hired 540 times, which was 30 times more than the same period of last year. The average transport distance was 7.29km, 0.24km more than the same period of last year. The average speed in hired time was 28.5km/h, improved 10% compared to the same period of last year.

During the period of drive one day less a week, nearly 60% car-owners took public transport on their car-free day. It is generally acknowledged that public transport had been considerably improved than before. For example, public transport capacity had been enhanced and public transport travel speed was a litter faster. In the same time, many passengers reported that public transport needs to be further improved in several aspects, including travel speed, interchange convenience, and punctuality etc.

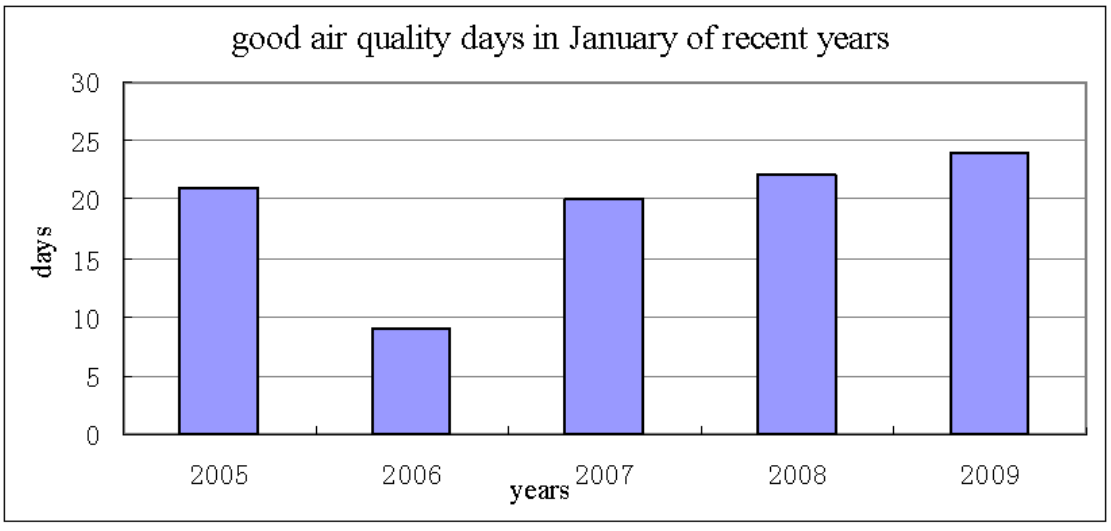
3.3 Evaluation on Air Quality

According to daily air quality data monitored by Beijing Municipal Environmental Protection Bureau, we evaluate urban air quality change before and after the implementation of drive one day less a week.

Since the measure of drive one day less a week came into force on October 11th 2008, Beijing's air quality was improving overall.

In October 2008, there was 8 days meeting the air quality's first level standard, 16 days meeting the air quality's second level standard, and 7 days meeting the air quality's third level standard. Good air quality day (i.e., exceeding the air quality's second level standard) reached to 24 days in total, accounting for 77.4% of the total days of the month. Overall, air quality was better than the same month of recent years. On the average, there were 5 good air quality days more than the same month of past 8 years.

In November 2008, good air quality days accounted for 80% of the month, which were 8 days more than the same month of past 8 years. It was the best level since 2000.



*Data source: Beijing Municipal Environmental Protection Bureau

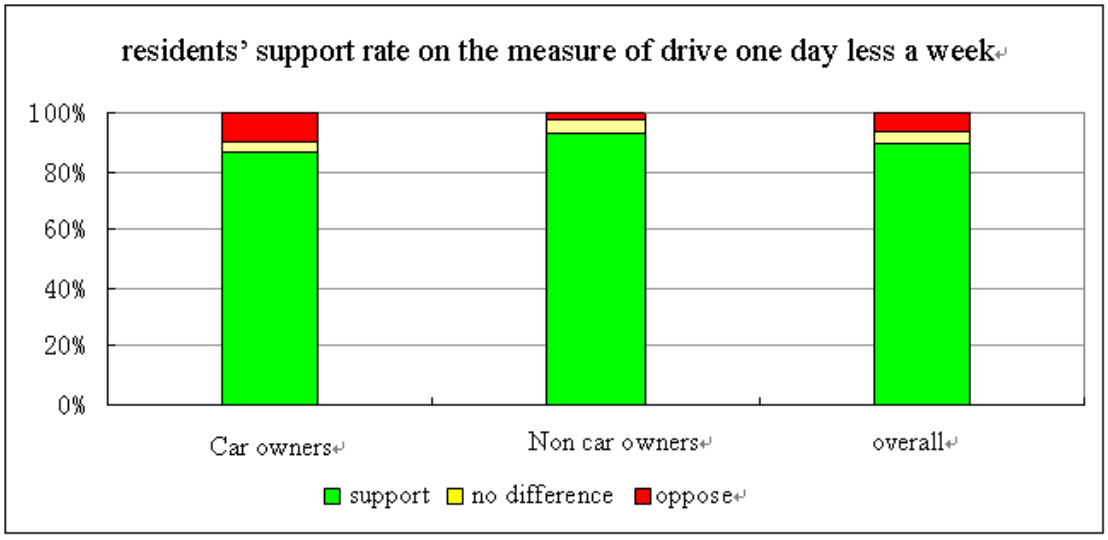
Fig. 1 Good air quality days in January of recent years

In January 2009, there were 24 good air quality days, among which the first level day was 5 days, the second level 19 days. It was the best level compared to the same month since 2000. Fig. 1 shows the increase of good air quality day in January of last 5 years.

3.4 Evaluation on Societal Responses

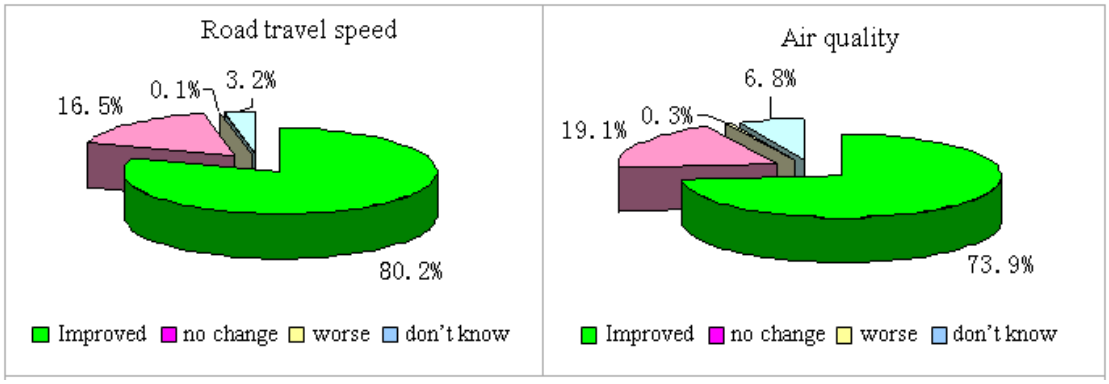
During 20th -22nd, February 2009, Beijing Horizon Research Consultancy Company collected 3603 effective samples through CATI (computer-assistant Telephone Interviewing System) and street intercept interviewing method. Among these samples, there were 2085 car-owning persons, and 1518 non car-owning persons.

89% residents supported the measure of drive one day less a week. The support rate in car-owning persons was 86%, and in non car-owning persons was 93%. Only 7% residents opposed the measure. The opposition rate in car-owning persons was 10%, and in non car-owning persons was merely 2%, as shown in Fig. 2.



*data source: Beijing Horizon Research Consultancy Company

Fig. 2 Residents' support rate on the measure of drive one day less a week

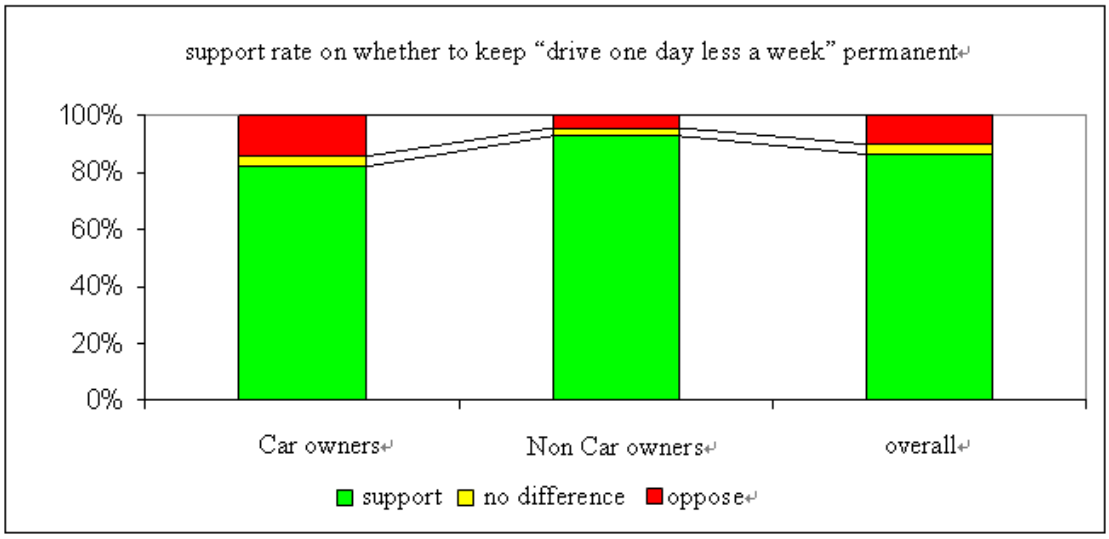


*Data source: Beijing Horizon Consultancy Company

Fig. 3 Residents' evaluation on the effect of drive one day less a week

Beijing residents generally acknowledged that transportation congestion was mitigated and air quality was improved after the measure of drive one day less a week had been implemented. 80.2% residents felt that travel speed was enhanced, and 73.9% residents felt that air quality was improved, as shown in Fig. 3.

After the measure of drive one day less a week has been implemented half a year, whether keep this measure permanently needs to be investigated. 86.6% residents supported to keep the measure in place. Among car-owning people, 81.9% persons supported to keep the measure permanent, while among non car-owning people, as high as 93.0% persons supported. Fig. 4 shows people response on whether to keep drive one day less a week permanent.



*data source: Beijing Horizon Consultancy Company

Fig. 4 Support rate on whether to keep drive one day less a week permanent

4. PERSPECTIVE ON CAR USE RESTRICTION POLICY IN BEIJING

4.1 Transportation Development Trend in Beijing

(1) Transportation Demand Keeps Increasing. Beijing population is more than 20 million people (including floating population) by the end of 2008. Since 2000, Beijing's domicile population increased by 1.4% per year, and floating population increased by 7.3% per year.

Transportation volume is now about 40 million passengers each day, increased by 90% over the last 5 years. It will increase by 20% in 2012, and reach 50 million passengers each day or so.

(2) Car Ownership Keeps Increasing. There are more than 3.8 million vehicles in Beijing at the end of September 2009. On average every family owns 0.75 cars. According to international motorization experience (1.5-1.8 cars per family on average in New York, London, Paris etc.), Beijing is at the car rapid increasing period. Car ownership will exceed 5 million in 2012 and exceed 6.5 million in 2015.

(3) Car Use Intensity Keeps Increasing. Total motor traffic volume has increased by 70% from 3.5 million cars each day to 5.9 million cars each day in recent 5 years. Car travel distance each time is also increasing. Average car travel distance was 8 km in 2000 and was

9.3 km in 2005, and it will exceed 10 km in 2010; however, average passengers each car transported is reducing. This means that to load the same transportation passengers, road burden is heavier and heavier than before.

(4) Transportation Modal Split Is Not Stable, And Car Transport Share May Exceed Public Transport Share Again. In recent years, public transport passengers in Beijing increase by 20% every year. On the average, public transport carries 18 million passengers each day. However, it is small compared to international public transport developed cities. Hong Kong has 7 million populations, and its public transport carries 11.25 million passengers each day. Tokyo has 33.5 populations, and its public transport carries 40.73 million passengers each day.

Public transport share in Beijing transportation demand increased from 28.6% in 2000 to 36.8% in 2008, exceeding car share 4 points in slight advantage. Public transport just occupies the dominant position in Beijing's transportation modal split. Transportation modal split may deteriorate if car ownership and use is not restricted rationally.

Now, the good effect of existing car use restriction measures is being counteracted by new increasing car traffic.

4.2 Recommendation for Future Car Use Restriction in Beijing

Widely proposed policies for reducing car use include discouraging car owners for driving, making driving less attractive, improving alternative travel modes such as public transport, biking, or walking. These policies differ in efficiency, cost, technical feasibility, and political feasibility. Vlek and Michon (1992) suggest that the following categories of TDM measures may be feasible ways of implementing car-use reduction policies (ordered from more to less coercive): *physical changes* such as, for instance, closing out car traffic, providing alternative transportation; *law regulation*; *economic incentives*; *information, education, and prompts*; *socialization and social modeling* targeted at changing social norms; and *institutional and organizational changes* such as, for instance, flexible work hours, or telecommuting. As they further note, the more coercive strategies may have negative side effects outweighing the expected benefits, whereas the less coercive strategies may be based on untenable assumptions about determinants of car use.

Single car-use reduction measure only produces limited benefits, and therefore, to implement integrated car-use reduction measures is a must. In Beijing, it is difficult to implement strict car ownership control measure in the future under the pressure of facing the slowdown in economic growth since automobile industry strongly stimulates economic development. Integrated car use restriction measure, therefore, is more important for Beijing.

According to Calthrop et al. (2000), there exist two sources of inefficiency in urban transport. First, the driving cost does not reflect the actual travel cost. This market failure is dealt with by road pricing. Secondly, few individuals pay for parking, or parking fee is not effective to guide car use.

We suggest that differential parking policy and congestion charge policy should draw up reasonably in Beijing to restrict car use, meanwhile less coercive measure should be

implemented permanently, such as information, education and prompts, or flexible work hour, or telecommuting.

The parking fee should be differentiated according transportation zone and time and play a role to restrict car use. Beijing Transport Committee has put forward the strategy of the differential parking charge. Differential parking charge scheme is under formulation.

Transportation congestion charge is growing in popularity as an effective instrument in responding to the concerns about high levels of traffic congestion (Asakura and Iryo, 2007). When the concept of congestion charge was introduced in China, it received more and more discussion in Chinese big cities. But it is difficult to put congestion charge into effective because of lack of public support.

We think that the implementation of the differential parking charge will promote the idea of congestion charge. The differential parking charge measure can be a starting point of conducting the congestion charge and make the idea of congestion charge gradually accepted in China.

5. CONCLUSION

The aim of this paper was to evaluate the effect of the car use restriction measures before and during and after the Beijing Olympic Games. Based on the evaluation results and the analysis of Beijing's transportation development trend, future direction of car use reduction policy in Beijing has been discussed which will not only differentiate parking charge but also enhance car driving cost.

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