Research on Transport Subsidies for Public Transit and Cars

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Abstract Creating a transit-oriented built environment and implementing the important economic policy of transport subsidy are effective means to promote the use and accelerate the development of public transit. The importance of the transport economic policy must not be ignored because a policy preference will possibly affect travel behavior to a great extent. Taking subsidy as an angle and the city Nanjing as an example, this article focused on analyzing and comparing the operating subsidy and disguised external cost subsidy for public transit and cars use. The result showed that the unit subsidy for cars is 11.8 times of that for public transit. This is extremely unfair and it goes against the established transit-oriented development direction. Furthermore, this article, based on stated preference survey data, analyzed the transfer of travel mode on the condition that free parking is cancelled. The result showed that more than 1/3 customers would turn to public transit and slow-moving traffic under that condition. In conclusion, this article brought forward policy suggestions, such as eliminating the subsidy for parking prices, setting maximum index of appertaining parking facilities instead of minimum index, subsidizing public transit, and increasing car-using tax, in order to achieve society equity and transit-oriented development.

Keywords Transport subsidy · Public transit · Car · Selection of travel mode · Development orientation

1 Introduction

Transit Metropolis is an urban strategy adopted to cope with the high-speed growth of cars, traffic congestion, and lack of transport and environmental resources. The connotation of Transit Metropolis is certainly not only limited to the "public transit

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priority plan" which belongs to the government system, but also it is about creating an urban environment beneficial to public transit from the perspectives of urban development and physical construction, such as urban spatial structure, land development, and new town design. Copenhagen, Curitiba, and Singapore have become world-famous Transit Metropolises for the harmonious symbiosis between their public transit service and urban physical environment (Susuki et al. 2013).

However, this article will not discuss further about those mentioned above. Because other than physical environment construction, the economic factor that cannot be ignored for promoting the use and development of public transit is another extremely important factor. Here is a simple example: The subsidy for public transit (including surface public transit and metro) in Beijing has reached up to 11 % of the whole city's financial expenditure, higher than the 7.2 % for social security and employment, but the embarrassing fact of surface traffic congestion has not changed yet. Therefore, this article attempts to explore more about the economic means, specifically subsidy.

As an important infrastructure of cities, urban public transit has an important influence on the overall benefit of the whole society. However, for public transit operators, it is difficult to ensure both social benefit and economic benefit, which determines the necessity of financial subsidy. At present, subsidy is provided for public transit in Chinese cities, especially megalopolises. But meanwhile, we feel that the subsidy generally considered for public transit also apply to car using, such as invisible subsidy mentioned later in the article—marketplace provides free parking in order to attract customers. Obviously, this goes against the policy of developing public transit preferentially, and brings about the transfer of travel mode and social injustice (Small and Verhoef 2007). Based on this cognition, this article emphasis on operating subsidies, using Nanjing as an example, to calculate and compare the travel subsidies for public transit and cars, and reveal the influence of subsidies on travel modes based on preference survey results. Through comparisons of subsides and studies of subsidy behavior, researchers hope to partly explain the preference of travel modes in Chinese cities and put forward policies and recommendations accordingly.

2 Review

2.1 Transport Subsidy Provided by the Government

Public transit is usually regarded as a public welfare undertaking. The majority of cities in the world are not making ends meet in public transit operations. The tickets income cannot cover the operating costs, and such loss is usually taken up by the government in order to ensure the normal operation of public transit.

For example, the Bay Area Rapid Transit system (BART) in the metropolitan area of San Francisco, USA, realized a fare income of only USD66 million, but had

operating cost of up to USD134 million from June 1983 to June 1984. Among the USD68 million subsidies, 86 % comes from the consumption tax collected by the local government, and the balance comes from property tax and others (Wachs 1993). The proportion of subsidy for public transit is also very high in Western European countries, and has reached up to 50–70 % in cities such as Amsterdam, Barcelona, Paris, Roman, and Glasgow (Abou-Zeid et al. 2012; Litman 2005). In China, the local government pays increasing attention to public transit undertaking. Taking Beijing, the capital city, as an example, the amount of subsidy for surface public transit and metro has increased from around RMB1.0 billion at the beginning of this century to RMB18 billion in 2013.

2.2 Transport Subsidy Provided by Employers

In the West, especially in the USA, it has become a custom for employers to provide commuter subsidy, or fringe benefit, such as employer-paid free parking in urban central areas. However, some states have broken this convention. For example, in the Parking Cash out Law promulgated in 1992, California required employers to provide another option for employees, and more employees selected cashing out (Willson and Shoup 1990). In 2008, the Bicycle Commuting Subsidy Bill signed by the American former president George W. Bush enabled bicycle commuters to obtain employer subsidy together with driving commuters and bus commuters (Heinen et al. 2010).

Things in China are different from those in the USA. Transport subsidy was included in the payroll even in the era of planned economy. But for a long time, the transport subsidy has not aimed at any certain traffic mode, and has been mixed together with other incomes. So it does not affect the selection of travel mode. Along with the social and economic development, some enterprises have begun to provide market-based subsidy aiming at customers' specific travel mode for certain purposes, and this behavior has affected the selection of travel mode, and so aroused the attention of this article.

2.3 Brief Summary

As a whole, the West seems to be more mature on this matter since it guarantees the implementation of transport subsidy policy by legislation. The subsidy for commuter travel has experienced the evolution from single subsidy for car commuters to the subsidy for multiple commuting modes including cycling, and this process is also accompanied by the gradual ripening of the society's recognition of the transportation, environmental, and social problems. The calculation of demand elasticity proves that public transit subsidy is an effective but not the best method for raising ridership. The West has developed many researches about the influence

of parking subsidy on travel behavior, and obtained convincing and credible conclusions. The subsidy for the use of cars is mostly explicit in the West.

At present, China pays increasing attention to public transit pricing mechanism and subsidy policy (Yang et al. 2010), but lacks studies on subsidy for nonpublic transit travel and contrastive studies on subsidy for various travel modes, as well as researches on the influence of subsidy on the selection of travel mode. In addition, the subsidy for use of cars in China is implicit, and is not perceived by most people.

Actually, at home and abroad, especially in the West, many researches have been conducted on the pricing of public transit subsidy and free parking. But surprisingly, there are few contrastive studies on the city subsidy for travels by public transit and by cars. This will be the topic mainly discussed in this article, and will reflect the guidance quality of urban transport development and the fairness of subsidy at present.

3 Method

In this article, the model used is not very complicated, and the research method is also relatively simple. This article focuses on the operating subsidy behavior in travel by surface public transit and cars. Such subsidy is possibly explicit, such as public transit subsidy, or it could be implicit, such as marketplace's policy of free parking based on shopping reaching a certain amount in order to attract customers. In addition, subsidy behavior occurs in the dynamic process of travel, such as public transit operation, and also in the static process of travel, such as cars parking. External cost is also a type of subsidy and will be discussed below. The calculation of subsidy amount for travels by surface public transit and cars will be detailed to every person time, in order to enhance the comparability.

The calculation of transport subsidy below takes the city of Nanjing as an example. Nanjing is the capital city of Jiangsu province with a population of 7 million. Owing to its superior geographic location, the city has remained the transportation center of the Yangzi Delta region. Nanjing is one of the historical and cultural cities in China. Nanjing bears the reputation of the Capital of Ten Dynasties, since the year 229 AD, it served as the capital of Wu, Eastern Jin, Song, Qi, Liang, Chen, Southern Tang, Ming, Taiping Kingdom, and Republic of China subsequently. Nowadays, Nanjing has developed into a multiple-producing industrial base in eastern China, an important hub of transportation and communication center, one of the China's four major scientific research and educational central cities. The gross national products of the whole city in 2013 amounted to more than 800 billion yuan, which has a 12 % increase compared to the previous year.

4 Calculation and Comparison

4.1 Calculation of Subsidy for Travels by Public Transit

Developing public transit is an inevitable choice for constructing a sustainable urban transport system, but public transit operation enterprises' policy loss is an indisputable fact. With Nanjing as an example, the government's subsidy for surface public transit was more than RMB500 million in 2010. Therefore, if ridership is clear as given, the amount of subsidy for each person time can be calculated (Table 1).

It may be known from the above table that the cost for travels by public transit is around 1.97 Yuan/person time, wherein, 1.40 Yuan is the amount actually consumed by passengers, and the remaining 0.57 Yuan/time is the governmental subsidy. This is equivalent to a subsidy of 0.562 Yuan/time for passengers (excluding senior citizens, under-aged passengers, and passengers living by government relief) taking surface public transit in Beijing in 2005 (Hao et al. 2009). However, if the utilization factor of subsidy fund is considered, then the actual subsidy for single travel by public transit will probably be less than 0.5 Yuan for management losses.

In such a case, in comparison with the subsidy for travels by cars, does such a subsidy appear high or low?

Table 1 Calculation table of the operating cost of and operating subsidy for surface public transit of Nanjing in 2010

	Parameters	Data	Calculation method
a	Ridership of surface public transit (billion person times)	10.08[a]	
b	Total cost (billion Yuan)	19.87[a]	
c	Cost per person time (Yuan/person time)	1.97	=b/a
d	Total tickets income (billion Yuan)	14.16	
e	Actual ticket consumption per person time (Yuan/person time)	1.40	=d/a
f	Average subsidy for single travel by public transit (Yuan/person time)	0.57	=(e − c)
g	Average time in bus per person time (min)	25.0[a]	
h	Average speed of surface public transit (km/h)	15.0[a]	
i	Average riding distance in bus (km)	6.25	=g × h
j	Subsidy per person time kilometer (Yuan/person time kilometer)	0.091	=f/i

Note [a] Nanjing Urban Planning Bureau 2011

4.2 Calculation of Subsidy for Free Parking

The full-process expense for travel by cars generally includes the following 3 parts: gas fee, parking fee, and cars depreciation. Currently, the domestic gasoline price in China mainly fluctuates according to the international gasoline price. And, since there is no governmental subsidy for cars depreciation, this article does not consider the subsidy for these two sectors, but only focuses on the subsidy of parking fee.

In China, most employers do not provide car parking space for employees. But in recent years, some large-scale commercial institutions have successively issued the policy of free parking for consumption reaching a certain amount in order to attract more customers, and this behavior is worthy of our consideration. For example, the Golden Eagle Emporium at Nanjing Xinjiekou Business Circle states in its free parking policy that customers may enjoy 2 h/4 h/8 h (upper limit) free parking for shopping of accumulatively over 400 Yuan/800 Yuan/1,500 Yuan on the same day, and the excessive part needs payment according to the standard of parking charge in Nanjing. As a matter of fact, two metro lines and dozens of bus lines pass by the Nanjing Xinjiekou Business Circle, and it is not really necessary to travel there by car.

On November 2, 2013, we conducted an investigation at the parking lot of Golden Eagle Emporium, and obtained 147 effective questionnaires in total. Data showed that these cars enjoyed 3.35 h free parking on average. According to the parking charging standard of Nanjing, they obtained a parking subsidy of averaged 19.5 Yuan in total actually. Each car carried 2.25 persons on average, so the unit subsidy amount was 19.5/2.25 = 8.67 Yuan/person time, about 15.2 times of the subsidy for surface public transit, as shown in Fig. 1. The calculation process is as shown in the following table (Table 2).

Obviously, free parking has brought about a bigger customer flow to the emporium, but also it has given rise to a new problem: The parking subsidy arising from free parking was by far higher than the governmental subsidy for public transit operation. According to the result of interviews, the respondents welcomed free parking; but when asked what if free parking were cancelled, over 30 % of them

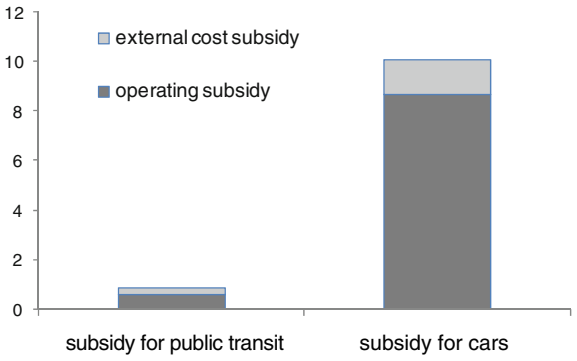

Fig. 1 Comparison chart of subsidy for public transit and cars

Table 2 Calculation table of subsidy amount under the free parking policy of the parking lot constructed by the Nanjing Golden Eagle Emporium

	Parameters	Data	Calculation method
a	Average duration of free parking enjoyed (hour)	3.35	
b	Parking subsidy actually obtained (Yuan)	19.5[a]	
c	Average passengers in each car (person time)	2.25[b]	
d	Unit subsidy amount (Yuan/person time)	8.67	=b/c
e	Unit subsidy for car/unit subsidy for public transit	15.2	=d/0.57

Note [a] According to the parking charging standard newly implemented in Nanjing in 2012, the parking fee/15 min charged by the off-road parking in first-tier areas was 1.5 Yuan, and the parking for the first 15 min was free

[b] *Data source* investigation data of November 2, 2013

expressed that they would consider changing the travel mode. Therefore, free parking has actually induced social injustice and the ambiguous orientation of transportation development (Shoup 1997). The practice of Golden Eagle Emporium is not a single case. Nowadays, this policy is also implemented by more than a dozen of commercial retail giants in the Nanjing City Center (Xinjiekou Business Circle, and Gulou Business Circle) and large-scale warehousing shopping malls such as IKEA and METRO in the outskirts of the city. Nanjing Jinrunfa Supermarket provides 2 h free parking on condition of shopping of only 50 Yuan, and becomes the merchant presenting the most lenient free parking conditions. In addition, large-scale merchants in multiple medium- and large-scale cities such as Beijing, Shanghai, and Guangzhou, also have the policy of free parking for shopping of over a certain amount, and undoubtedly, this attracts citizens' patronage by driving, and becomes one of the important factors inducing urban traffic congestion and air pollution.

4.3 Calculation of Subsidy for External Cost

Currently, China does not charge fees related to external cost (including air pollution, noise pollution, climatic warming, and traffic accident) during the driving, so it may be regarded as an implicit subsidy. The estimated total external cost of the four factors combined is 0.275 Yuan/VKT in 2005. Similarly, the bus has external cost, which is around 0.864 Yuan/VKT (Wang 2011). In case the external cost of buses is on average amortized to individuals, and the average passenger capacity of a bus is 35 passengers, then the per capita value of public transit subsidy for only external cost will be 0.864/35 = 0.025 Yuan/VKT, only 1/11 of that for car.

According to investigation, 147 drivers' average round-trip mileage for shopping is 11.56 km, so the external cost of travel by car is 11.56 × 0.275 = 3.18 Yuan, and the per capita value is 3.18/2.25 = 1.41 Yuan/person time; if there are 35 passengers in a bus, then the external cost arising from the same-distance driving by bus will be

Table 3 Calculation table of external cost of travel

	Parameters	Data	Calculation method
a	External cost of unit car VTK (Yuan/VTK[a])	0.275[b]	
b	External cost of unit bus VTK (Yuan/VTK)	0.864[b]	
c	External cost of unit bus passenger VKT (Yuan/person time VKT)	0.025	=b/35
d	Average round-trip mileage of cars (km)	11.56[c]	
e	Average number of people carried by car (person time)	2.25[c]	
f	Per capita external cost of each travel for shopping by car (Yuan/person time)	1.41	=a × d/e
g	Per capita cost of each travel for a same mileage by bus (Yuan/person time)	0.285	=c × d

Note [a] VKT is short for vehicle kilometers traveled
[b] Wang 2011
[c] *Data source* data of investigation on November 2, 2013

0.864 × 11.56/35 = 0.285 Yuan/person time, which is by far lower than that of travel by car (Table 3).

The comparison of subsidy for travels by public transit and car is as shown in Fig. 1. Obviously, no matter whether in terms of operating subsidy or the implicit subsidy for external cost, the whole society's subsidy for travels by public transit is much less than that for travels by car, and the total subsidy for car (10.08 Yuan/person time) is 11.8 times of that for public transit (0.855 Yuan/person time), which is extremely unreasonable. This creates a social polarization and an unfair policy for the dominant urban transportation mode. For travelers and consumers, they are encouraged to use cars more by broad Downs Law (Downs 1992).

5 Conclusion and Discussion

According to the analysis, the subsidy arising from both the operation section and external cost for public transit is by far lower than that for car, and after the two items are lumped together, the difference in unit subsidy is discovered to be even more than 10 times. This actually embodies "car priority," instead of "public transit priority." What is more, compared with the commuter subsidy in North America, these subsidies seem to be more implicit, and have aroused few people's attention. The investigation on residents sufficiently shows the stimulative function of free parking on travel by car. Obviously, transport subsidy deeply affects travel behavior, which in turn affects the determined urban transportation development orientation.

Concerning subsidies for various travel modes, we shall first eliminate the welfare of parking prices, namely, de-welfarization. Under the circumstances that urban land resources are extremely scarce, the behavior of executing low price not

corresponding to the high cost of parking space resources, and even providing free parking to the public is distinctly featured by the maximization of suppliers' welfare, instead of social welfare, and is actually partial to the high-income group. The substance of subsidy rests with wealth redistribution, and can only flow from the high-income group to the low-income group. Therefore, free parking toward high-income group is naturally neither reasonable nor fair.

Another problem shall be emphasized, namely, the appertaining parking facilities. The government shall prudentially consider the demand-driven element, that is, the scale of appertaining parking spaces, especially in urban central areas, and shall not calculate the number of parking spaces to be constructed with trip generation rate index widely applied to Traffic Impact Analysis (TIA), but shall lower the standard of appertaining parking spaces constructed, and make the highest, instead of the lowest, construction standard. Under such circumstances, developers even do not have to construct appertaining parking spaces for the reason of cost control, and so, it may be called "cancelling the construction of appertaining parking facilities." Considering relatively low supply level, the market will only tighten the supply of parking spaces, and raise the parking fee (Shoup 1999; Willson 1995, 2013). Since the 1990s, Singapore has started to tighten the quantity of parking spaces in downtown area, and allowed developers to reduce the construction of appertaining parking spaces by 20 % at the most. A highlighted case is that the Market Street Auto Park located in CBD and initially constructed in the 1960s provided 704 parking spaces, but these parking spaces were closed in 2011 (Land Transport Authority (LTA) 2013).

It is an effective way to promote the establishment of a sustainable and transit-oriented urban transportation development mode through so-called push-pull effect, i.e., the subsidy for travels by public transit and the taxation during the use of the car (Bly and Oldfield 1986; Sakai and Shoji 2010; Savage and Schupp 1997). Obviously, starting with the construction of transit-oriented urban transportation development mode, we shall provide subsidy for public transit, eliminate all subsidies for the car, and raise various taxes from owning to using cars. The taxation aiming at cars and the subsidy aiming at public transit shall be corresponding, that is, the various over-levied taxes shall be applied to the development of public transit. Specifically, we shall raise fuel tax and innovatively charge parking adjustment fee, and a tax reform aiming at both driving and parking of cars is undoubtedly advisable, and will be effective eventually.

Finally, the author considers that the built environment and public transit facilities should play an important role in promoting public transit development and building Transit Metropolis, but reemphasizes that the economic factor should never be ignored, since various improper subsidies will surely lead to consequences not in accordance with the original intentions of urban and transportation planning. When built environment is out of order and fails in creating transit-oriented circumstance, reasonable economic means could be able to turn the passive situation around.

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