Co-Benefits of a City Toll in Chinese Cities: Barriers, Potentials and the Need for Responsible Institutions

Abstract

Car dependence fosters increased congestion and air pollution locally, while contributing to climate change globally. Chinese cities undergoing extreme rapid motorization and urbanization face these issues at an unprecedented level in a short time period. Comprehensive transportation demand management (TDM) measures, including urban road pricing, have the potential to lessen these impacts. While the overall impact of a city toll are considered beneficial, from a political economy perspective these benefits must alleviate the reservations and concerns of users, particularly motorists. In China, reforms and decentralization have paved the way for more entrepreneurial leadership and political careers are now intrinsically linked to economic growth and, partially, to the automobile industry as a central economic pillar. Many institutions are neither designed nor have the capacity to handle the dynamism inherent with greater motorization. We propose and examine strategies to reducing barriers to the implementation of a city toll in Beijing and other Chinese cities, and identify crucial stakeholders. In particular, we address inequitable distribution of impacts, loss aversion, land-use development that promote car traffic, institutional deficits and indicators that emphasize economic growth. We propose to align a city toll with extended public transit, mixed-use and transit oriented development, and increased emphasis on capacity development and sustainability indicators. We also discuss ways how China's pattern of isomorphic development of different regions can be leveraged to promote TDM measures.

1. Introduction and scope

Transportation was responsible for 23 % of the world's CO_2 emissions in 2006 (International Energy Agency, 2008). The transportation sector has shown significant growth rates throughout the world – more than any other sector. Starting from low baseline demand, China is assumed to play a tremendous role: 43% of additional world oil demand by 2030 is projected to come from China (International Energy Agency, 2008). Three quarters of transportation-related emissions originate from on-road motor vehicles, a significant part in urban areas. However, to city leaders the social benefits and many of the costs of motorized transport are more immediate than climate change. Increased traffic results in economic losses due to lost time, higher operating costs, poor air quality, noise pollution and increased traffic fatalities. These problems are especially acute in China. Many of its more prosperous cities are undergoing very high motorization rates that overwhelm existing infrastructure. Also, Chinese oil demand exceeds domestic supply. Hence, multiple factors –urban economic development, health concerns and energy security, as well as climate change, – impel the government to redirect urban economic development towards sustainable transportation infrastructure. Within this context, we consider the potential role of transport demand management (TDM) in achieving this goal.

Chinese cities exhibit high population densities, low road density, and rapid motorization. We argue that these attributes,demand the swift development of transport demand management technologies and measures. TDM can be utilized to ensure that demand and social costs of transportation are matched. A typical example is restriction and pricing of parking to reduce inner city traffic and achieve a high turnover rate of users of valuable parking space. In this chapter, we focus on a comprehensive TDM measure, a city toll addressing congestion, air pollution and climate change damage. A city toll, combined with good public transportation facilities and mixed-use land development, leads to huge benefits, amplifying the positive effects of more specific measures. The considerable co-benefits of sustainable transportation policies in Chinese cities include reduction of air pollution and congestion, traffic safety improvements for cyclists and pedestrians and improved reliability in bus service (Creutzig and He, 2009). In contrast to climate change mitigation, these co-benefits are local and relatively near short-term, as such being more relevant for policy makers (Pearce, 2000). Although these benefits have been identified, government agencies are reluctant to act, facing a set of barriers.

In this chapter, we analyze barriers to sustainable transportation policies in Beijing, focusing on the city toll. In section 2, we detail existing transportation policies in Beijing and evaluate their degrees of success. In section 3, we summarize the co- benefits of a city toll and integrated transportation planning in

Beijing, constituting the background to our subsequent barriers analysis. In section 4, we investigate the barriers to a Beijing city toll. We focus first on the distributional aspects of a city toll, and then discuss loss aversion, land-use development that promote car traffic, institutional deficits and indicators that emphasize economic growth..While these aspects are not intimately linked to a city toll, they hinder its implementation. In section 5, we propose countermeasures to overcome these barriers. In section 6, we discuss the framework of isomorphism in urban development and the role of other Chinese cities that may prove to be pioneers in implementing a city toll. In section 7, we conclude with an outlook on action on local, national and international level.

2. Current policies – TDM measures in Beijing and other Chinese cities

China's automobile ownership is predicted to continue to rise 20 percent per year. Of the six million cars purchased in China in 2007, 600,000 were bought in Beijing (Beijing Statistical Yearbook, 2007). Ten percent of all Chinese motor vehicles are located in Beijing, even though only one percent of the population lives there. Hence, Beijing is a focal point for investigation of urban car policies in China. What are the current transport policies in place?

2.1 Parking management

One of the first TDM policies that Beijing implemented was parking fees. Parking, in general, is one of the less controversial policies to implement because people accept the rationale of paying for the use of a parking space. In recent years, the municipal government has also sought to restrict the number of new parking spaces available in the downtown area while simultaneously increase parking fees (Xinhua, 2007). However, enforcement still needs considerable improvement. For example, some motorists have created their own parking spaces on sidewalks (Beijing Traffic Management Bureau, 2008). Also current parking fees do not capture the costs of providing the parking and are too low to significantly influence modal choice. Since many cars are government-owned or company cars, numerous motorists get their parking fees reimbursed, as has also been documented for Shanghai (Feng and Ye, 2008).

The Beijing municipality has also provided limited park-and-ride facilities. Since 2007, Line 5 has a park-and-ride center at Tiantongyuan North subway station with a parking fee (2 RMB/day). In the 11th five-year plan, Beijing plans to build 26 Park-and-Ride centers outside the 4th ring road.

2.2 Driving ban

Between July 20 and September 20, 2008, Beijing implemented a car ban, limiting road access based on license plate numbers. Once in effect, Beijing's road traffic showed significant improvements –vehicle speeds increased dramatically, particularly during the Olympics, when morning and evening peak periods

traffic speeds increased by 26.9% and 22.8% respectively (Green Report, 2009). In parallel, public transit ridership rose from 35% in the first half of 2008 to 45% (Green Report, 2009). The car ban, along with other policies, lowered Beijing's air pollution index to 36% below the average of the preceding eight years.

Seeing its success, the Beijing Municipal Government followed up with a modified driving ban, scheduled to expire in April 2010. With the modified ban, drivers are not permitted to drive one day out of the week. Despite temporary progress in congestion relief and air quality, Beijing drivers oppose these measures. Many private motorists feel entitled to drive their car daily and policies that restrict daily use of a car are considered akin to a restriction on private property rights (Qiu 2008; Economic Observer Online, 2008). The car ban currently in effect may make other alternative measures such as a city toll more attractive to drivers. Implementation of a city toll would allow to would permit the city to simultaneously eliminate the driving ban.

Other demand management measures are already in place. For example, expressways are already tolled by advanced electronic toll collection.

2.3 Car ownership regulations

Shanghai is the only province that restricts car purchases; it limits the number of automobiles through license plate auctioning. As a result, Shanghai has a significantly lower car ownership rate than Beijing although the city has comparable income level. Personal communication with planning officials in a few cities indicate that most feel they could not restrict car use like Shanghai, as they are historically or politically not as strong as Shanghai. In response to the success of the Olympic car ban, officials have considered restricting car purchases. However, according to Wang Haiping, deputy head of the Beijing Municipal Development and Reform Commission, limiting car purchases at this time would be irresponsible as China is trying to boost domestic consumption to offset the impacts from the global financial crisis (Xinhua, 2008). This viewpoint is reflected in national policy measures. For example, the central government has reduced car fees to ensure the automobile industry meets its sales goal (Xinhua, 2009).

Restrictions on vehicle purchases or registration help to lower the overall number of personal cars, but not usage. For example, the Hong Kong government limits the number drivers through high fees. Yet, these motorists have high vehicle kilometers traveled (Cullinane and Cullinane, 2003). Motorists drove their car because of the high sunk costs and comparably small marginal costs.

2.4 Public transit

What kind of supply-side policies can induce a sustainable modal split? A comprehensive summary of measures is given by Goodwin (2008). Here the focus is on suitable measures that are relevant for Beijing.

For motorists, time savings trump monetary operation costs. In fact, faster public transportation can induce significant modal shift as seen in Seoul where a 10% increase in speed of public transportation induced 5% of all car drivers switching to bus and subway (Lee et al, 2003). For the Olympic Games, Beijing expanded its subway system from 56 km to 200 km in total and plans to expand it further by 2015 to a total of 560 km. When Line 5 went into operation and fares were reduced to 2 RMB per trip in 2007, ridership nearly doubled from 1.9 million trips a day in 2005-2006 to 3.4 million trips a day in 2008. The planned network would triple overall capacity and accommodate an additional 10 million trips a day, similar to the number of motor vehicle trips each day in 2005. However, the current growth in transportation demand in general and car transportation in particular suggests that additional subway capacity – as a solitary measure - only flattens growth in car transportation.

The Beijing Municipality implemented additional measures to prioritize public transit (Green Report, 2009), initiating the "Storm of Affordable Public Transit". Measures attracting car owners to public transit included: smart cards (Public Transit Electronic Card), reduced fares, new and improved buses, optimized bus routes, and dedicated bus lanes (51.5 km were added in 2007).

Despite the increased capacity and ridership of the subway, the bus remains the backbone of Beijing's transportation system. In 2005, daily bus trips outnumbered subway trips by a ratio of 4 to 1. Unfortunately, buses must compete for road space with cars; dense traffic slows bus speeds, causing more drivers to switch to personal vehicles. In Beijing, bus transportation is plagued with extraordinary low speeds, mainly due to congestion. A comprehensive bus rapid transit (BRT) system with dedicated lanes could double operational speed from 10 to 20 km/h. This measure effectively doubles capacity, potentially adding 8 million passengers a day, without requiring an increase in the number of vehicles. A bus rapid transit system, well implemented and operated, can be cost–effective. However, access to public transit alone is not enough to induce modal switch from car to public transition[1].

3. Benefits of a city toll for Beijing

The scale of Beijing's gridlock encompasses more challenges than other megacities. In a recent study, Creutzig and He (2009) analysed the social costs of motorized transportation in Beijing in 2005. The

[1] For example, 50 percent of motorists surveyed in Nanjing lived within walking distance of public transit that was a direct line to work (He et al, 2005).

analysis was restricted to the area inside the 6th ring road, corresponding to around 10 million inhabitants. The social costs of air pollution and congestion each amounts to approximately 20 billion RMB annually in the lower cost estimate[2]. This is significantly larger than climate change damage costs (1.4 billion RMB per year). However, the magnitude of uncertainty is higher for climate change damage costs than for other disbenefits. In the upper cost estimate, climate change damage is equal in magnitude to both air pollution and congestion. The resulting lower cost estimate is summarized in Table 1.

Table 1. *Social costs and co-benefits of a city toll. Source: Creutzig and He (2009).*

Beijing case study	Cost estimate in billion RMB (2005)	Monetized co-benefit of city toll
Congestion	22.8	14
Bus speed reduction	5.8	1.5
Air pollution	19.8	5.3
Climate change	1.4	0.4
Accidents	4.0	-
Noise	0.9	-
Total	**54.7**	**21.2**

The role of a congestion charge or city toll in reducing social costs and creating co-benefits was also analysed (Creutzig and He 2009). According to welfare theory, the theoretically optimal toll would maximize congestion relief at the least collective individual cost. We found that a 27% reduction in car transportation would result in 14 billion RMB per year in driving time saved. Importantly, other social benefits add up to 7.2 billion RMB per year, mostly due to cleaner air whereas climate change mitigation only corresponds to 0.4 billion RMB per year at current carbon prices. An overview of the benefits is displayed in the right column of Table 1. For the average car driver, such a city toll would mean a toll of 35-45 RMB per day. One possible implementation scheme would charge 1 RMB per km inside the 4th ring road and increase to 3 RMB per km inside the 2nd ring road. As a result, the average speed would increase from 21.5 km/h to 27.8 km/h.

City tolling would be highly beneficial not only for the local economy but also for overall quality of life. However a city toll alone is insufficient; motorists cannot switch when no competitive alternatives are available. Together with a city toll, improved public transportation service, bicycle networks, and safer, pedestrian-friendly streets make it easier for drivers to use their cars less. Practically, car owners can more easily switch to other modes. Technically, these measures increase demand elasticity and reduce opportunity costs for car drivers while scaling up the benefits of city tolling. Additionally, the increased

[2] Costs of congestion are monetized lost value-of-time as indicated by a survey of Beijing residents. Air pollution costs are based on willingness-to-pay. The low cost estimate of climate change impact is based on ~\$20/tCO_2. Results are detailed in Creutzig and He (2009)

availability of rapid public transit allows the reduction of the city toll and thus the burden for car drivers while achieving the same traffic reduction. In London, expanded bus services and the congestion charging scheme resulted in increased bus use (Transport for London 2007).

The combination of measures acts synergistically and can significantly reduce vehicle miles traveled. In Figure 1, the co-benefits of a city with and without extended supply-side measures are detailed. Fortunately, the rapid expansion of public transit and improved bus services are planned for the next years (see section 2) and thus provide the basis for a city toll scheme. A more formal study of the interaction of charging and supply-side measures via demand elasticity can be found in Creutzig and He (2009).

Given Beijing's skyrocketing transportation demand and rising per capita GDP, the two main drivers of auto ownership, expanding public transportation service alone is insufficient. Higher fuel taxes could alleviate the situation marginally. However, only a city toll can appropriately address congestion and local air pollution, thus creating significant co-benefits. In fact, the municipal government has discussed congestion charging measures for several years. What are the barriers that have prevented implementation?

A primer on city tolls

A congestion charge was introduced as a theoretical concept by Pigou (1920) to internalize transportation externalities. The major externality is congestion, i.e. the value of time lost by other road users. Time benefits differ across road users. For example, leisure traffic has much lower value of time than commuting or business trips. The main idea of a congestion charge is that the road user is charged the difference between individual and social costs, by this paying the marginal social cost of road usage. In effect, this reduces road usage to its social optimum (reducing congestion and environmental pollution). Practically the revenue can be used to compensate those affected by externalities. A detailed explanation of road pricing is presented in Newbury (1990). Road pricing can also be used to address environmental externalities as part of a mixture of approaches (Button, 1990). The economic rationale for a generalized congestion charge for Beijing – a city toll addressing congestion, air pollution and climate change - is explained in Creutzig and He (2009). A congestion charge can be regressive, neutral, or progressive, depending on location, design and mode choice (Santos and Rojey, 2004). In particular, when car drivers have income above average - as is the case in Beijing, richer people will pay the toll and poor people will not. A city toll is often regarded as the theoretical first-best solution but afflicted with numerous barriers and constraints and often not optimal in real-word settings. For example, toll schemes become more feasible choosing a soft implementation path (Rouwendal and Verhoef, 2006). The driving ban measures in Beijing can be used as an intermediate step on an implementation path towards a city toll. More

generally, real-world solutions deal explicitly with institutional and behavioral constraints and understand a city toll as part of a package solution.

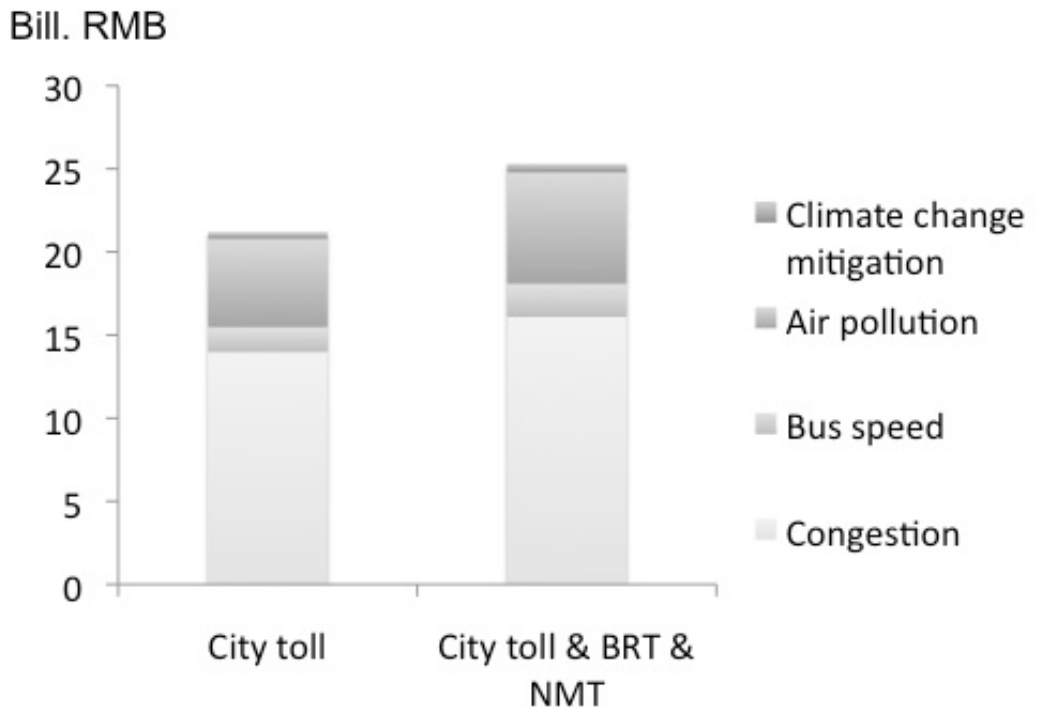

Figure 1. *Co-benefits of a city toll and with additional supply-side measures. Source: Creutzig and He (2009).*

4. Barriers

In the following we discuss five barriers that would need to be overcome before congestion pricing could be successfully implemented. Technological barriers are excluded because Beijing already has some elements of an intelligent transportation system in place and Chinese governments have shown that they are willing and able to adopt advanced technologies rapidly.

4.1 Distributional effects

It is widely accepted that integrated transportation demand management measures, such as a city toll tied to public transportation improvements, are beneficial from a macroeconomic perspective. However, individual agents and groups have to bear specific costs or receive specific benefits according to their socio-economic status, mode choice and susceptibility to environmental harm. A congestion charge is commonly challenged on the grounds of alleged regressive effects. Hence, distributional effects must be analyzed and addressed by the specific design of a city toll.

Distributional Impact of TDM Measures. Costs of congestion charging are not evenly distributed across the city population. Obviously, car drivers have to carry the burden. However, car drivers will also profit the most: time savings and more reliable transportation. Furthermore, not every car driver will pay the same cost and will profit equally. Also, users of other modes will be affected specifically. We start with three not necessarily exclusive groups of car drivers and then proceed to other modes:

- Wealthy motorists can afford city tolls without significantly impacting their other forms of consumption. Furthermore, they value time-savings the most. This is eminently true for work trips where, in addition to trip duration, reliability of arrival time is important. Time-saving benefits increase with income. As benefits (time savings) increase supra-linearly (mostly exponentially) with income level, benefits for high incomes are also exponentially larger than for those motorists with relatively low income.

- Lower-income motorists are still rich compared to their non-motorist counterparts. However, they would be significantly impacted by the marginal costs of transport and have a relatively low value of time. This segment is larger in Beijing than in other Chinese cities as policies such as low vehicle taxation have promoted car ownership in the middle class. A city toll may force these middle income car owners to to switch to other modes or to make other compromises in their use of discretionary income. Their relative costs – so-called opportunity costs - are then dependent on additional time spent in public transportation or on the electric bike, and other factors such as comfort and status. Those with good access to public transportation will have relatively low opportunity costs.

- Government officials and business people often have access to company cars. These cars make up a considerable portion of traffic, particularly inside the 2nd ring road, a suitable candidate area for a first city toll. If government agencies and companies pay the toll, there would be no incentive to drive less.

- Taxi drivers would profit from congestion charging if drivers switch from car to public transportation and then take a taxi for casual trips. They would lose out if taxi passengers switch to other modes as tariffs increase due to the city toll or if car owners use transit during the congested periods and use their cars off-peak. Empty taxis are particularly sensitive to price signals (Ma, 2005), a city toll would reduce cruising.

- Cyclists including riders of electric bikes would profit from congestion charging because they would benefit from the induced reduction in car traffic, improved safety, and more road space. In fact, many cyclists have switched to other transit modes, such as public transit, because of poor

traffic safety; some presumably would switch back. Some streets could lose their character as physical barriers to cyclists and pedestrians and become more desirable streets for these modes, with increased bicycle and pedestrian flows and greater safety.

- Pedestrians profit from higher accessibility, safer roads, better air quality, and less noise-induced stress.[3]
- Bus patrons would profit significantly from higher operational speed. With respect to the high mode share of bus in Beijing this is one of the most significant benefits.

An equity analysis of a hypothetical congestion charge to a typical Chinese city suggests that cross-modal equity of road space allocation would increase even without taking revenue redistribution into account (Juan et al, 2008). This increased equity, demonstrated by a lower Gini coefficient, is mainly due to more road space allocation to bus and electric bikes (Juan et al, 2008).

Redistribution of the Revenue. The city toll can be interpreted from two rationales:

1. Reducing car dependence to balance individual benefits and social costs
2. Implementing the polluter-pay principle, i.e. let those that are responsible for environmental harm or social costs pay the damage or compensate victims

The first is achieved by implementing the city toll. The second can be achieved through proper redistribution. The social costs of public space needs, congestion and air pollution affect all citizens in similar magnitudes[4]. Congestion affects motorists and bus riders and to a certain degree cyclists and pedestrians. Hence, the revenue could be redistributed as a lump sum to all city inhabitants[5]. In many cases, externalities lower-income families are more affected by externalities. For example, they often live close to noisy roads. From a market-based perspective, this externality is already priced in by lower rents. Debates continue as to whether health and life expectancy issues should be subject to the market. Regardless of these debates, a city toll and lump sum redistribution can be considered beneficial for lower-income residents.

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[3] Effects are dependent on specific circumstances. If a city toll induces a switch from congestion to dense but steadily flowing traffic, environmental harm may persist. If a city toll reduces overall car traffic, also noise levels and safety will significantly improve.

[4] Details are much more complicated. Richer car drivers benefit the most by monetized value-of-time whereas poor citizens are at a disadvantage in monetary terms as they cannot pay for either health or free-flowing traffic. However, the poor suffer more from air pollution and other environmental hazards and will benefit significantly in terms of health.

[5] From a fairness perspective, migrants without a Beijing *hukou* (户口,household registration of permanent residency) should participate. This may not be possible without redesigning the *hukou* system.

Perceived Costs and Benefits of a City Toll. So far, we have discussed the overall costs and benefits of a city toll. Our perspective was that of an external observer with assumed perfect knowledge commenting on horizontal equity between different social groups. However, the individuals concerned have a different perspective and experience different distributional consequences across time, so-called longitudinal equity.

The relationship between a city toll and its benefits is opaque to many people. Few readily appreciate the advantages of a city toll such as congestion relief and time saved. The relationship between asthma and automobile exhaust is also difficult to grasp. A city toll and its implied benefits is a statistical one and derived from a relatively abstract framework. In reality, benefits are dependent upon a specific set of circumstances taking place and seem uncertain to many people. Furthermore, these benefits are not instantaneous; they will occur some time in the future. For example, health benefits may only become apparent in the next decade or even longer, and may be difficult to measure. In contrast, costs of a city toll are very concrete. This relationship of valuing present costs higher than uncertain and sometimes unknown future benefits is commonly referred to as loss-aversion. "The political difficulty with congestion pricing is persuading people to do it in the first place, not in convincing them of the value after the fact" (King et al, 2007). In fact, once congestion pricing is in place, most drivers become used to it.

Taking the proposed city toll into consideration, motorists in Beijing would stress their costs but underestimate their time and reliability benefits. Taxi drivers would also emphasize their additional costs - though they could be one of the groups benefiting the most – and threaten to invoke another strike. And non-car users are highly unlikely to promote a city toll as their benefits may be perceived as relatively small.

This motorist bias is amplified in political spheres. Motorists are well represented in government and have, as a group, greater access due to their economic status. In contrast, the majority of Beijing residents who are non-motorists have relatively little influence and weaker organizational support. Individual effort translates into high transaction costs but benefits are uncertain and relatively marginal for the individual - though aggregated benefits would be huge.

4.2 Social status

Analyses of the Chinese automobile have focused on the utilitarian functions of cars and their environmental impacts but have been ambivalent about the emerging social significance placed on cars (Gan, 2003). To what extent are cars becoming a part of modern Chinese culture? In a 2004 *Gallup Poll*, Chinese respondents stated that a brighter future included owning a car. Anecdotal evidence points to the car as a key ingredient for upward mobility. For example, one man stated in an interview: "Without this

car, my two sons wouldn't be able to find wives -- the girls would not marry them" (Bradsher, 2008). Cars provide access into a better class existence and provide better opportunities. They have become embedded in modern Chinese society.

Four-fifths of all new cars sold in China are bought by people who have never owned a car before (Bradsher, 2008). In a motorist study that looked at travel characteristics in Nanjing, drivers stated they initially bought the car for work (He et al, 2005). Yet, it soon became an essential part of their lives. Even though Nanjing is only 8.7 kilometers from the center to the outer rim, daily kilometers driven per car averaged 26 kilometers (He et al, 2005).

From the beginning, the central government has given strong signals to motorists that a car encompasses more than economic status. They were also given power over the roads (Liu and Guan, 2005). For example, traffic enforcement was and continues to be lax. Many drivers received licenses without proper training or understanding of traffic laws. Municipal governments have allowed sidewalks to become makeshift parking lots and cut bike lanes in size to provide cars with more road space. New roads have been designed without bike lanes (Schipper and Ng, 2004). Guangzhou's government took it a step further in 1994 and set a goal of eliminating two million bicycles by 2010 to promote automobile sales (Riley 2002, citing Harwit 1995). Traffic police focus their attention on moving traffic and less on enforcing moving violations. The central government recently slashed taxes and fees to encourage car ownership (Xinhua, 2009) because of the current economic decline.

In Beijing, the benefits of private car ownership are immediate and tangible. As a result, motorists vehemently oppose pricing measures. The resistance poses one of the most significant barriers towards the implementation of a charging scheme.

4.3 Land-use impacts

China's shift to an auto-oriented path of development has produced significant land use issues, including sprawl. Liu and Guan (2005) found that many lower income and middle class urban residents are being forced into suburban areas. Compact development and rapid motorization are in conflict. In fact, Beijing's Municipal Master Plan restricts its population to 18 million by 2020, 7.5 million people are to be dispersed to new towns (Liu and Guan, citing the Beijing Master Plan 2005-2020).

While most sprawl was initiated *before* China had a considerable car population (Zhang, 2000), the rise of car ownership has fueled it. These suburban areas usually have weak public transit infrastructure, further encouraging car dependence. In parallel, new gated-communities, which make a small percentage of suburban housing, are being built in the outskirts of Beijing (and also Shanghai) targeting the rich car owner. Some of these real estate developments have names and themes that are linked to western auto-

oriented cities, such as "Orange County," located outside of Beijing. Orange County's homes are modeled after the same single-family homes found in the sprawling Southern California city (Rosenthal, 2003). Also, displaced citizens from the gentrified inner city hutongs are placed in affordable housing units on the city fringe, sometimes with limited access to public transit.

4.4 Institutional barriers

In Beijing, different agencies are responsible for land-use and transport regulations. The responsible institutions are (Xue, 2009):

- The Beijing Municipal Bureau of Land and Resources (BMLR) regulates, monitors and approves land conversion for housing developments.
- The Beijing Municipal Commission of Housing and Urban-Rural Development (BMCHURD) regulates, monitors and regulates housing developments.
- The Beijing Municipal Commission of Transport (BMCT) plans transportation services and infrastructure.
- The Beijing Transportation Research Center (BJTRC) provides analysis, data and suggestions for transport planning.
- The Beijing Municipal Commission of Development and Reform (BMCDR) plans comprehensive balancing of the city's economic and social development policies. A city toll would need approval of the BMCDR.
- The Beijing Municipal Environmental Protection Bureau monitors air pollution standards.

Collaboration and coordination is limited, impeding sustainable TDM measures. No cohesive mandate for any agency integrates transportation (or accessibility), environmental and health concerns into a coherent framework. In the current setting, each agency follows its own narrow goals.

The Chinese governmental structure is plagued with asymmetric policy making and implementation, where local leaders "are the agents of higher-level governments" (Yang et al, 2007). Within this context, they are reluctant to cooperate with other agencies or citizens on urban planning issues. Silo-style planning, in which departments make decisions separate from each other, is ubiquitous. This not only hampers the implementation of transport demand management measures but also forestalls an integrated treatment of the economic and environmental impacts.

While transportation agencies have experience in road construction, they lack experience in innovative transport demand management measures. Transportation planning falls to engineers who may lack planning experience and vice versa (Yang et al, 2007). Furthermore, planners in general have a difficult time influencing leaders' decisions because urban planning policies are seen as obstacle to growth

(Zhang, 2000). As in most countries, the capacity to implement a city toll or congestion charge is almost non-existent. Thus, many decision makers are hesitant to implement a city toll or similar transport demand management measures.

4.5 One-dimensional indicators

To leaders, cars signal China's economic success and demonstrate that it is one step closer to modernity. In fact, the Chinese government chose the automobile industry as a pillar industry because "no truly modern country in the world lacked a developed passenger car mode of transport" (Riley, 2002). Inspired by the economic successes of South Korea and Japan, the Chinese central government set out to create an automotive industry in the eighties. It played and continues to play a major role in encouraging and guiding the Chinese automobile industry, through establishing joint ventures (Thun, 2004).

Liberalization policies implemented in the early nineties allowed for extensive decentralization and shifted the revenue generation to local governments. As a result, many local governments formed pro-growth coalitions in alliance with the business sector. During this time, the central government sought new ways to steer the economy on a new course and regain power it lost through decentralization (Thun, 2004). The central government was searching for a major industry to drive the economy and turned to the automobile industry as an economic pillar (Anderson, 2005).

In 1994, the National Development and Reform Commission issued the Household Car Policy (汽车进入家庭), which provided and promoted incentive programs to allow more people to purchase cars. Driver's licenses were restricted to work units previous to 1994. Ownership restrictions were eventually removed – meeting the aspirations of upwardly mobile citizens (Johnson, 1995). By 1999, many citizens in major urban areas could become car owners.

The most significant factor in car ownership is income level (Riley, 2002). Hence, with recent economic growth, China's car manufacturing became a major industry and a pillar of its economy (Committee on the Future of Personal Transport Vehicles in China, 2003). Furthermore, in 2004, the second automobile policy was put in place, giving increased financial support to the automobile industry to encourage lower prices. These policies proved successful. By 2004, China was the second largest manufacturer in the world and in January 2009, it became the largest automobile market in the world[6].

The overarching objective for promoting car manufacturing and ownership is its function as base multiplier. Automobile industries are the prototype of an *economic export base* that allows local growth of non-export economies. Base multiplier theory and more recently, new economic geography,

[6] This is also due to the crash in car sales in the United States.

demonstrate that regions develop successfully around a strong export industry of specific products, by localizing economic wealth (Krugman 1991). In China, the three dominant economic regions are Bo Hai belt including Beijing, Pearl River Delta and Yangtse River Delta, with the Yangtse River Delta acting as the automobile industry base (Chen et al, 2005).

The careers of local politicians are driven by economic performance (Li and Zhou 2005). The most important criteria for career advancement are gains GDP, FDI and fiscal revenues (Edin 2000). Furthermore, the typical tenure has been reduced to 2-3 years in the post-Mao reform period. Hence, leaders now focus on short-term measurable economic success. Other governmental functions, such as environmental protection and social welfare, are also mandated, but do not seem to be as important to advancement.

These central government policieshave fostered a Chinese car class (Gan 2003). Local governments also encourage automobile ownership through urban planning initiatives because of the perceived economic benefits to their cities (Zhang and Hu 2003). If measures such as a city toll are seen as a deterrent to automobile ownership, local officials will not support them.

5. Countermeasures

5.1 Fair distribution by appropriate toll design

From a distributional point of view, there are two circumstances that pose a barrier to city tolls:

1. Disproportionate influence of those that may lose more than they gain: Car drivers in general, and government employees who are used to car privileges.
2. Gains are uncertain and future-oriented while losses are fixed and immediate.

A pragmatic city toll takes these two barriers explicitly into account. Revenue distribution should be transparent and preserve motorist choice (Harrington et al, 2001). For Beijing, we suggest that transportation and urban planners consider the following measures.

- Part of the revenue should be directly used to offset car drivers' losses. For example, the city could consider scrapping taxation for car ownership upon the introduction of the city toll.
- New bus lines and BRT systems should be introduced jointly with the city toll, immediately offering transportation alternatives.
- Revenues should be redistributed in advance in terms of mobility benefits for everyone. For example, every citizen should receive a charged smart card that she or he can use for the subway, bus, parking fees and city tolls.

- The government's reimbursement policies for parking fees and road charges should be revamped to increase efficacy of a city toll. In exchange for giving up car subsidies, government and business officials could obtain a relatively generous mobility allowance via their smart card.

This design guarantees that material benefits are perceived at the start, which may significantly reduce opposition. The design is technically feasible as smart cards are already widely used and accepted in Beijing. An advanced smart card version could be used for automatic payment at tolling gates, similar to Singapore's design.

Specific mitigation measures for less affluent motorists may be difficult to implement. However, the vast majority of car drivers in Beijing can be considered relatively rich. Crucially, an early statement of the intention to implement a city toll can give economically vulnerable drivers time for adaptation.

In a study on Los Angeles, King et al (2007) proposed to earmark the money for specific people and places, to gain political support. For Beijing, the relative distributional impact on both space (districts) and organizations (municipal and national agencies) should be further studied, with revenue distribution and management authority allocated accordingly.

5.2 Explaining co-benefits

What can be done about the car as status symbol and emotional resistance of citizens? The London experience helps to identify a list of concrete success factors to persuade the public and realize a city toll implementation (Transport for London, 2007). Beyond procedural measures and good practice (clear roles and responsibilities, feedback from stakeholders, etc.), the following issues contributed to success:

- *Political leadership:* clear objectives were given from the Mayor's office and there was continual engagement.
- *Research:* Sound quantitative knowledge of transport conditions and issues as an essential prerequisite. The traffic conditions were monitored at all stages and detailed simulations were provided.
- *Public information campaign:* Issues were explained to the public such that the purpose and the individual handling of the scheme could be understood. The messages were be delivered as a straightforward tone of voice, i.e. as a information and not as a marketing campaign. Compliance is the non-plus-ultra of charging schemes. Compliance can only be achieved if the majority accepts the objectives of the scheme as reasonable.

For Beijing this means that institutions like the Beijing Transportation Research Center (BJTRC, the municipalities think tank on transport issues) come forward with research on how a city toll could foster a

sound transportation system. In particular, it should identify what kind of toll design could help the Mayor to develop a positive profile. From there, public relation agencies such as the Beijing Municipality Office Bureau and on national level the State Administration of Radio, Film and Television can play a crucial role. A public information campaign that clearly states the necessity and advantages of a toll could persuade residents of its progressive nature. It could also address habituation and perceived property rights. The campaigns should target motorists and identify the benefits, such as better traffic conditions and faster travel (Harrington et al, 2001). Taxi drivers should be briefed on the expected advantages of more potential custumers. Also, the co-benefits of reduced air pollution and more blue sky days should be promoted. Cyclists and pedestrians should be addressed separately, explaining their accessibility and health benefits. As cars are currently aspired by the majority of Chinese and seen as the ultimate status symbol it is furthermore important to demonstrate that other modes such as BRT or cycling can have their own status. For example, political leaders and public role models can promote fashionable e-bikes.

Altogether, it may be too ambitious to break the high status of cars in the mid-term. The Chinese government is interested in promoting the automobile industry. Hence, the campaigns may focus on reducing car usage rather than car ownership.

5.3 Integrated land-use policies

The recommendations for land-use policies are relatively clear and are directed to urban planners and national administrative bodies in charge of development regulations. When uncontrolled development produces car dependence, a city toll cannot mitigate car use but only harms commuters. In fact, transit-oriented development policies that link land use and transportation are a prerequisite of a city toll and are part of the package. Job centers, residential and retail areas need to be located near major transportation hubs. However, proximity cannot be the only measure. Barrier-free accessibility to public transit is a key concept of transit-oriented development. Safe, pedestrian-friendly street designs increases life quality directly and also improves access to public transit. A case study in Shanghai indicates that access to railway transit reduces commuting time, increases job availability and holds promise for placing rapidly suburbanizing Chinese cities on sustainable pathways (Cervero and Day, 2009). As discussed in section 2, Beijing is investing in subway transportation in admirable dimensions. However, regular bus transit still could be vastly improved through separate, closed bus lanes. Business activities are highly concentrated in two dense business districts inducing tremendous mono-directional commuting from bedroom communities to these locations (Zhang, 2007). Hence, it is also important to increase or rather retain accessibility through mixed-use. The Beijing Transportation Research Center and other agencies are well aware of this problem but so far have failed to persuade politicians to change planning practices. On the

bright side, a considerable number of transportation policies that are already in place can easily be coordinated with a city toll (Section 2 and Table 2).

Table 2. *The relationship between existing transportation policies and a city toll. Source: authors.*

Transportation policy	**Relation to city toll**
Electronic toll collection on expressways	• Technological learning already established • Road users experienced with tolls
Parking management	• Reduces parking conflicts with bikes, pedestrians • Can work together with city toll (Singapore experience, Feng and Ye, 2009)
Car ban and car ownership restrictions	• Intermediate step on an implementation path towards a city toll; can be ended upon introduction of city toll • Refocus on restricting car usage instead of car ownership
Public transit	• Provides alternatives and hence prerequisite for city toll • Lowers opportunity costs and difficulties of required charge
Park-and-ride	• Allows flexible modal combination, however: • Can be in competition to attractive high-density living close to subway stations

5.4 Institutions, knowledge distribution and capacity building

The problems resulting from institutional segregation should be avoided be creating an integrated agency for transport, demand management, urban development, and environmental issues related to transport.

As a first step on national level, the new Ministry of Transport combines the functions of the Ministry of Communications and the Ministry of Construction on urban passenger transport management. The super-ministry will also take over responsibility of the State Post Bureau from the Ministry of Information Industry. The aim of the reorganization is to establish a convenient, efficient, safe and integrated traffic system. Previously, transportation planning and transportation engineering were separate functions. The Ministry of Construction focused primarily on planning aspects. The Ministry of Communications oversaw highway construction. Having all of these functions within one ministry may help with

coordination.

In many cities, these bureaus are still separate entities. The success of integrated transportation and land-use planning has been demonstrated in Madrid (Matas, 2004). In Beijing, it is crucial that the five agencies detailed in 4.4 (BMLR, BMCHURD, BMCT, BMCDR, BMEPB) develop a coherent and encompassing vision or even merge some of their responsibilities. The actual toll would be set by the Beijing Municipal Development and Reform Commission (BMDRC) and will require their support. Hence, the BMDRC could take the lead in reforming the institutional segregation. Even with integration, new strategies for addressing transportation are needed. Transportation agencies must abandon their heavy reliance on supply-side strategies (Zhang and Hu, 2003).

Where does the required institutional change come from? Internal pressure from within the municipality administration such as seen in Shenzhen will be crucial to reshape institutions. However, given the political system of top-down control, change towards integrated planning requires action by the central government, e.g. by the National Development and Reform Commission (NDRC). At the same time, central agencies have limited knowledge of local problems. For successful and accepted design of a city toll, citizen participation must be part of the planning and implementation process.

In addition to institutional re-organisation, additional soft measures are required. In particular, quantitative studies could help to persuade policy makers of TDM's significance. Furthermore, municipality performance evaluation should include environmental indicators and modal share. Related to knowledge distribution is capacity building. This entails the education of transport engineers on sustainability matters and appropriate measures, as done by workshops of the Sustainable Urban Transport Project (SUTP). Furthermore, the Clean Air Initiative Asia, the Energy Foundation's China Sustainable Energy Program and other NGOs and international organizations are investing in workshops targeting mayors and engineers on TDM measures. Education of transport engineers in Singapore helps to distribute regional knowledge on successful implementation of road pricing programs and sustainable land-use. To counter the current lack of capacity in TDM and sustainable transportation systems, NGOs, national and international agencies need to further invest into capacity building.

Table 3. *Barriers, solution strategies and stakeholders.*

Barrier	Solution strategy	Stakeholders
Inequitable distribution of impacts	• Careful design to mitigate harmful effects • low transaction costs (smart card) • up-front benefits (e.g., BRT) • expert support from, e.g., Singapore and London	• Urban and transportation planners • Beijing Transportation Research Center (BJTRC)

Perception that policy is all costs, no benefits (loss aversion)	• Information campaign on benefits, focusing on air pollution and congestion reduction • Promote BRT and NMT improvements	• Beijing Municipal Office Bureau (public relation department) • NGOs
Land-use policies that worsen congestion (single use development, etc.)	• Transit-oriented development regulations • Retain and increase mixed-used developments	• National government • Municipal agencies
Institutions and capacity for implementation are undeveloped	• Mandate for integrated transportation agencies • Capacity building • Knowledge distribution	• NDRC • BMLR, BMCHURD, BMCT, BMCDR, BMEPB • NGOs, think tanks
Indicators of success and inventives to leaders promote more auto ownershio and use	• Re-evaluation of economic growth concept and car ownership strategy • Promote auto ownership for off peak use • Increasing emphasis on additional indicators, such as air quality and accessibility	• NDRC and ministries • International community

5.5 Sustainability indicators

Understanding that government performance cannot be solely measured by GDP growth, other objectives should be included as measures of success. Given the high visibility of these measures, indicators will have influence on policy decisions. In fact, monitoring and measurement not only gauge but also spur sustainable development (Meadows, 1998; Bossel, 1999). Reasonable indicators for Chinese cities could include PM10 level for air pollution, GHG emissions, and congestion in terms of speed reduction and equity of accessibility. The Beijing Transportation Research Center (BJTRC) and the Beijing Municipal Environmental Protection Bureau (BMEPB) record most of the data needed for these indicators. However, propagation of these data to the public and to other agencies is limited. Fortunately, the Olympic Games has helped to promote increased awareness of the air pollution problem. Also, on national level Pan Yue tried, unsuccessfully, to introduce a Green GDP, demonstrating that some members of the government are aware of the need for performance measures beyond pure economic throughput.

6 Beyond Beijing – projects of city tolls in Chinese cities

The London congestion charge has initiated public discussion in smaller British cities such as Manchester and Cambridge. The need for a congestion charge in these cities is not clear as the urban areas are much

smaller than London. The situation is different in China. Thirty urban areas have more than three million inhabitants, and many of these cities are already significantly congested. Projected rapid motorization, relatively high population density, and serious air pollution suggest that aggressive transport demand management is an issue beyond Beijing. What is the prospect for the diffusion of sustainable TDM in China?

6.1 Isomorphism of urban development

In the economic domain, Chinese local governments tend to formulate and implement similar or identical policies (Chien, 2008). In the context of economic globalization, local governments implement policies designed to attract foreign direct investment. In fact, China's rapid economic development is attributed to actions of local governments (Oi, 1995; Qian and Stiglitz, 1996). Success in specific development zones, such as Shenzhen, spurred huge growth and helped these regions leapfrog into the 21st century, GDP-wise (Walcott, 2002). Other regions copied these role models, giving rise to development isomorphism. 19 out of 30 regions chose to promote the automobile as a priority industry.

Several mechanisms were identified that promoted isomorphic development (Chien, 2008). First, regulation by the national government forced regions to follow similar policies. Second, local governments competed for preferential policies from the central government and FDI - each of them often conditional on each other – by implementing favorable local policies. Third, uncertainty over policy outcome, especially untried policies, is large, and policy innovation is seen as risky. Hence, mimetic learning set in, and local decision makers copied neighboring cities' successful practices. Fourth, cross-regional promotion and rotation of successful leaders occurred. Fifth, consultancy came from the same group of agents such as the Chinese Association of Development Zones or the China Urban Design and Planning Institute. Altogether, these mechanisms led to the implementation of similar sets of policies that were sometimes successful but also resulted in a race to the bottom in terms of air pollution and environmental destruction by competition for FDI.

Isomorphic development provides a way to understand both the barriers to introducing TDM measures and ways to foster these sustainable transportation policies. Currently, however, the central government provides few incentives to promote sustainable development. Local decision makers face great uncertainty in their political career when they attempt innovative policies such as a city toll. Mayors are unsure if such policies will impair or boost their standing in Beijing. Hence, most will not pursue sustainable transportation policies even if they are sympathetic to their objectives. The first municipality to implement TDM measures has to overcome the highest barriers.

Also, normative involvement, such as the promotion of sustainability concepts, by professional consultants is still relatively weak. However, the Clean Air Initiative Asia, the Sustainable Urban Transport Project and the Energy Foundation's China Sustainable Energy Program are just some of the organizations that put considerable effort into transforming the normative structure and building capacity.

6.2 Which city will take the risk first?

China's tendency toward isomorphism also indicates that if an influential city such as Beijing successfully implements sustainable transportation policies, other cities are more inclined to follow. Though individual cities will still confront barriers to congestion pricing, the pattern of isomorphic development demonstrates that Beijing's introduction of TDM is the most difficult hurdle. This means, the implementation of new TDM policies in Beijing becomes even more critical: Beijing as a locus of the central government naturally is a role model for other Chinese cities. Policies implemented in Beijing have greater significance and influence. Other possible cities include Shanghai and Shenzhen. Shanghai has over twice the population density of Beijing but a similar population (>17 million). However, because of its license plate auctioning, Shanghai has managed to keep overall car ownership significantly below Beijing numbers. In fact, auctioning license plates was explicitly been introduced to curb congestion and air pollution. Furthermore, congestion charging is currently being discussed within the Shanghai municipality (Reuters, 2007; Feng and Ye, 2008) .

Shenzhen is a rapidly developing city in Guangdong Province located at the mouth of the Pearl River Delta close to Hong Kong and one of the original special economic zones. Shenzhen attracted foreign capital and as a result became the 4th richest city in the country, experienced the fastest population growth of all Chinese cities between 1990 and 2000 as well as high growth in per capita income. This development also led to an explosion of car ownership and worsening air pollution (Güneralp and Seto, 2008). At the same time, Shenzhen is a laboratory for innovative policies in China. Currently, the Shenzhen municipality is in the initial planning phase of a city toll. In August 2008, the Planning Bureau of Shenzhen invited international and national representatives on congestion charging to discuss the feasibility and impacts of different charging schemes.

7. Conclusions

We summarize a set of reasonable actions to reduce political barriers to the implementation of a city toll, or more generally, sustainable TDM policies in Chinese cities.

7 .1 Local solutions and measures

Implementation of a city toll is conditional on leadership and good management practices.A city toll implies a huge redistribution of revenue. In fact, the revenue is larger than the combined societal benefits (Creutzig and He, 2009). Redistribution must be clarified from the beginning through extensive public education campaigns. Addressing distributional concerns, a toll must take into account equity effects from a fairness perspective and relative benefits of individuals across time and authorities must communicate these benefits actively - not to get into defense to start with. Uncertainty about potential costs and benefits must be reduced to dampen loss-aversion caveats. As a key measure, every citizen should receive a charged smart card – valid for at least public transportation and city tolling – upon the introduction of the city toll. As company cars represent a high share of all automobiles in the city center, car benefits for government and business cars should be replaced with mobility benefits on the smart card which then could be used for any transport mode. Both economic theory (Creutzig and He, 2009) as well as the insight from the London and Singapore experience clearly demonstrate that pricing measures work best and possibly only in combination with a set of other instruments, most notably improved supply of rapid public transit. Package solutions can overcome the substantial barriers to sustainable TDM measures. With the opening of three new subway lines in 2008 and planned aggressive extension to 560 km by 2015, improved bus service and current bicycling habits, Beijing municipality is in a good position to introduce a city toll.

However, Beijing's government agencies are not ideally positioned to handle transportation and environmental/ social costs and benefits within the same framework. A mandate for integrated transportation management, also addressing public health and environmental consequences, is necessary. The government of Madrid, which created an integrated planning agency in 1986, provides a possible model. Other model cities include London, Singapore, and Hong Kong.

7.2 National support

Incentive structures for mayors in China that focus on economic growth but not on social and environmental wellbeing are clearly counterproductive. The central government should shift its evaluation of party members from GDP indicators to a more integrated indicator set that includes environmental, accessibility and equity measures. Evaluation should also be not purely indicator driven so that leaders will focus on more than improving their statistics. Similarly to the municipal level, integrated planning of environment and transportation should be facilitated by institutional reorganization. The Chinese government has indicated its growing concern about upcoming climate change impacts and it may be

willing to support TDM measures not only for transportation efficiency but also for climate change and air pollution mitigation.

7.3 International support

Lacking capacity and knowledge hinders many promising TDM measures, including city toll implementation. International agencies and NGOs play an important role here in changing the normative structure and building crucial capacity building. Though Beijing citizens will mostly be concerned with congestion relief and clean air, international agents may also be motivated by considerable GHG mitigation. Efforts by multilateral development agencies or the Global Environmental Facility have focused on technological support and expertise, e.g. by hydrogen-powered busses. Such measures often lack institutional sustainability and cannot be scaled up. In fact, because of its further-reaching long-term potential, capacity building for comprehensive TDM measures is more cost-effective and produces larger environmental benefits than technology-targeted CDM measures. With combined effort and good management practices TDM measures for sustainable cities can be successfully implemented in China.

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