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Towards the solution of urban transport problems in China

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Abstract—The number of cars is increasing rapidly in most cities around the world including those in China. Access to a car increases the range of opportunities available and confers status. The construction of cars can also be a major contributor to a national economy and provide many jobs. However, mass car ownership brings many problems including environmental damage, resource depletion, congestion and inequality. In this paper the nature of urban transport problems in general is examined, and then the extent to which these are applicable in Chinese cities is considered. Then the future of transport in such cities is considered using some projections by the World Bank. It is shown that the problems will become much worse if no policy intervention occurs, but even with significant investment, the quality of the environment will deteriorate.

Keywords: transport, China, Beijing, cars, policy, cities.

1 The nature of urban transport problems

Most large cities around the world are suffering from problems caused by transport, including congestion and atmospheric pollution. These stem from increasing car ownership and use. The car enables its owners to enjoy a range of opportunities, more and more households adopt a lifestyle which is totally dependent upon the car which makes reducing car use very difficult.

As more people use the car, fewer use public transport. This reduces the revenue received, which leads to fare increases to try to cover costs. This can lead to further patronage loss. This cycle continues, leading to fewer and fewer people on public transport, thereby placing demands upon the government, local or national, to provide revenue support so that those who have no opportunity to use the car, often the poor, the old and the infirm, can continue to have mobility. It also means that investment has to come from the government.

As car use increases, the negative effects of the car grow. These include atmospheric pollution, use of fossil fuels, noise, and road accidents. In the long run, more and more people will be free to choose their locations, this will lead to increased demand for cars and pressure for more roads, which may lead to visual intrusion and community severance.

Thus it can be seen that the underlying trend is towards more car use and less public transport use, and that this trend will accelerate unless action is taken. In the remainder of this paper the types of action that can be taken and the possible effects will be considered. It is worth making the point that the car is not, in itself, evil. People want cars because they offer the opportunity to enjoy a better quality of life, and any action to reduce car use must recognize that people need to be allowed to maintain that high quality of life or else the action will fail on the grounds of unacceptability to the public. There is a role for education of the public to make them aware of the implications of their actions, particularly of the effects that the collective actions of many people, each trying to each improve their individual quality of life, has on society in terms of environmental damage, accidents and so on. In the next section the implications of these trends in the context of Chinese cities will be considered.

2 Transport problems in Chinese cities

In this section the extent to which these are happening in Chinese cities will be considered. Most of the focus will be on Beijing, but many of the arguments will apply to other large Chinese

cities.

Chinese cities differ from cities in some other parts of the world in a number of ways:

(a) Stage of economic development: China is going through a major process of industrialization, which means that cities are growing rapidly as people migrate from rural areas to cities to gain economic advancement. This means that demand for urban travel is increasing rapidly, including demand for cars. The processes of industrialization and urbanization have led to major deterioration of the quality of the environment, to which transport is one contributor (World Bank, 1998).

(b) Bicycles: There are huge numbers of bicycles in Chinese cities, and these have significant impacts on the transport system, and so must be included in any analysis.

(c) Socialist character: Sit (Sit, 1996) argues that the low levels of investment in road investment by the municipality of Beijing is a consequence of the philosophy of the People's Republic of China (PRC) that resources should be directed towards "productive" activities rather than "consumption" activities including transport. He also argues that the socialist philosophy has led to much lower expenditure by households on commuting than in most Third World countries (2% compared with 10%). This latter reflects public ownership of passenger transport and high levels of subsidy, as well as high levels of bicycle ownership.

(d) Nature of the road network: Zhang (Zhang, 1991) argues that the traditional road network in Beijing, with many narrow roads, makes it difficult to change the nature of the network. Interestingly, Sit (Sit, 1996) argues that the policy of building wide boulevards in recent years has been a waste of resources and made bus use unattractive because of the long walking and waiting times.

Comparing the percentage travelling on each mode of transport for all trip purposes in Beijing in 1991 (Spencer, 1996) with the figures for London in 1991 (London Research Centre and Department of Transport, 1994), we can find: The dominance of the bicycle as a mode in Beijing can be seen. The second most important mode is bus. Walk comes third with about 14%. The other modes carry less than 5% of trips each. This picture can be contrasted with London where car is the dominant mode. Rail-based public transport is more significant than bus in London. In London the main transport problem is congestion caused by the car. Beijing has the opportunity to avoid this problem if action is taken in the near future to address the issues (It must be recognized that there are already high levels of road congestion in Beijing, but that these will become much worse as car ownership increases).

Of course, there are already many transport problems in Beijing which need to be addressed. Car ownership in China is low at present relative to other east Asian countries for two reasons: higher residential densities and more integrated land uses (World Bank, 1997). Notwithstanding this, the registrations of cars and minibuses rose by 66% between 1990 and 1992. Until 1994 individual car ownership was discouraged, but in that year the government affirmed its policy of making the manufacture of cars a "pillar" industry and began encouraging private ownership of cars (World Bank, 1997). Despite the low levels of car use, traffic speeds are slow and this leads to high levels of fuel consumption. Congestion affects the performance of buses and causes "stop-start" driving which increases emissions from vehicles. According to Spencer and Wang (Spencer, 1996) the average speed of a bus in the period 1970 to 1975 was 24 km/h but by 1988 this had decreased to 15 km/h and as low as 7—8 km/h in the evening peak near the city centre. According to Spencer and Wang (Spencer, 1996) such slow bus speeds are often attributed to bicycles, but they cite evidence by Guo (Guo, 1996) that bicycles only cause congestion at bus stops when other

vehicles are hemming them in.

The air quality standards in China are low. According to the World Bank (1997) Chinese emission standards allow forty times more carbon monoxide, six times as many hydrocarbons and eight times as many nitrogen oxides as US standards. The current Chinese standards do not require the fitting of catalytic converters in order for them to be met. Motorcycle standards are even lower than those for cars. Part of the problem arises from the outdated vehicle designs. The standards are weakly enforced. A related problem is the poor quality of petrol in China. A related issue is the low price of petrol by international standards.

There are several public transport modes in Beijing: buses, trolley buses, metro, taxis and suburban passenger train. According to Bushell (Bushell, 1994) there are about 3000 buses in Beijing, 2000 of them articulated, and about 500 trolleybuses, of which 75% are articulated. The first line on the metro was opened in 1969, and the second in 1984. Construction on the third line commenced in 1992. The three forms of public transport are run by separate subsidiary companies of the Beijing Public Transport Corporation. Interchange between the metro and surface modes tends to be poor with few escalators and no purpose-built links for transferring passengers (Bushell, 1994). According to Spencer and Wang (Spencer, 1996) consideration was given to constructing a new rail line to the northwestern sector of the city using a high-technology system with automatic trains powered by linear induction motors similar to the "Skytrain" system in Vancouver in Canada. The Canadian government was considering offering financial assistance for this, but this was not forthcoming after the political events of June 1989. Whilst this would have been a prestigious scheme to have, it does not seem to be very sensible to have such a capital-intensive project in China where labour costs are low and there might be difficulties in importing spare parts.

The importance of bicycles in Chinese cities has been mentioned. As the Chinese economy grew during the 1980s and households became more prosperous, the number of bicycles in Beijing grew from 2.88 million in 1980 to 8.38 million in 1990 (Liu, 1993b), a growth rate of over 11% a year. In a city of 10 million residents this implies a bicycle ownership of over 800 bicycles per thousand population, and an average of several bicycles in each household. Liu *et al*. (Liu, 1993a) argue that bicycles offer the following advantages: flexibility (for short journeys compared with public transport), economy (in terms of demand for road space compared with cars), efficiency (in terms of energy consumption), affordability and environmentally soundness, but have the disadvantages of not being suitable for long journeys and in poor weather conditions and making users vulnerable in road traffic accidents. Transport policies to encourage bicycle use include monthly subsidies to bicycle users, subsidization of bicycle parking in most agencies and increasing capacity of bicycle manufacture to keep prices down (Liu, 1993a). At an operational level, more than 50 road interchanges with special facilities for bicycles were built in Beijing during the 1980s (Liu, 1993b).

Thus it can be seen that Beijing has a complex transport system involving huge numbers of vehicles resulting in many problems. Many initiatives are being taken including improved traffic management, public transport initiatives, changes in transport fees and phasing out of leaded petrol (World Bank, 1998), but it is clear that there is scope for further action, as there is in most large cities. Some aspects of the future will be considered in the next section.

3 The future of transport in Chinese cities

The World Bank (1997) has considered some of the possible futures for Beijing and other Chinese cities. The major issue is the growth in car ownership. The number of privately owned

passenger vehicles in China increased from 19000 in 1985 to 786000 in 1995, an annual average increase of 45% (World Bank, 1997). It argues that the following factors will influence household car ownership levels in China: affordability (the ratio of car price to per capita income), the need for car use, and the infrastructure available for car use.

The World Bank (1997) has made a series of projections of possible scenarios of the future of Chinese cities. The assumptions underlying these projections are not clear, and it is not being argued here that these scenarios are accurate predictions of what will happen, but they do illustrate a number of important points. The first point is that car ownership is expected to grow in Chinese cities and this underlies the future of urban transport. In Table 1, the current level of car ownership is shown to be 24 cars per thousand people. This is projected to increase to 96 cars per thousand people by 2010. The second point to be made is that some other factors will influence this trend, for example residential densities and the quality of public transport. In the former case, if residential density is allowed to decrease as the city grows, the level of car ownership will be higher than would otherwise be the case. Similarly, if the quality of public transport is allowed to decrease, car ownership will increase. It should be noted that even if public transport is improved and residential densities are maintained, car ownership in Beijing is projected to be over three times as high as at present. In other words, this type of policy intervention can help to reduce the growth in car ownership, but it will not stop it growing (Only direct action to prevent growth, such as rationing, would have a significant effect, but this would be very difficult to implement. Such a policy may also conflict with a policy of encouraging the growth of the car-manufacturing industry for economic development reasons).

If it is not possible to restrict car ownership, there is a strong case for discouraging car use. A pre-requisite for the successful implementation of such a policy is an attractive alternative. This implies a strategy of investment of public transport. Table 2 shows projections by staff of the World Bank (1997) of the annual investment in two scenarios: one for a car-based strategy, the other for a public transport strategy. It can be seen that the car-based strategy would be more expensive because of the higher cost of building and maintaining roads compared with the cost of buying new buses and building metros and light rapid transit systems. Of course, this says nothing about the relative benefits of the two strategies, in terms of environmental improvement, travel-time savings and development effects.

Table 1 Projections of car ownership per 1000 people in Beijing in 2010

	Current residential density	Residential density reduced
Current situation	24	
Basic projected rate	96	
Better public transport	77	92
Worse public transport	106	116

Source: World Bank (1997)

Table 2 Projections of the annual investment in urban transport in China, 2000—2010, for two strategies in billions of US dollars

	Car-based strategy	Public transport strategy
New roads	14.9	8.9
Road maintenance	12.8	9.4
Buses	1.4	4.0
Metros and light rapid transit	0.0	1.8
Total	29.1	24.1

Source: World Bank (1997)

The effects on the environment of implementing traffic management and emission-reduction measures, and a public transport strategy are illustrated in Table 3. The forecasts suggest that the use of petrol and diesel will increase to 25 times the base year level if present policies are pursued. It is predicted that imposing stronger vehicle emission measures and introducing a public transport strategy will cause the increase to be five-fold. The increases in pollutants would be to about 25 times the base year levels, reflecting the forecast increase in car use. Introducing the emission measures considered under the second scenario would have a significant impact on all the pollutants, particularly on lead. The public transport strategy together with the vehicle emission measures, would mean that lead would be zero, but that all the other pollutants would be above the 1993 levels. Particulate matter would increase the most, followed by nitrogen oxide.

Thus it can be seen that action is required to try to reduce the adverse impacts of the transport system, particularly as a result of increasing car ownership. Even drastic measures are unlikely to prevent significant increases in the damage caused, but could prevent some of the worst excesses.

Table 3 Projections by the World Bank of the use of fuels and pollutants produced by transport in Chinese cities in 2020

	Base year, 1993	Current (car-based) policy framework	Car-based strategy with traffic management and vehicle emissions measures	Public transport strategy
Petrol (10^6 tons)	29	789	473	144
Diesel (10^6 tons)	8	144	86	49
Carbon monoxide (10^6 tons)	8	215	55	16
Lead (10^3 tons)	4.6	126	0	0
Nitrogen oxide (10^6 tons)	1	22	9	3
Volatile organic compounds (10^6 tons)	1	23	6	2
Particulate matter (10^3 tons)	80	1838	868	362

Source: World Bank (1997)

4 Conclusions

Like all large cities around the world, cities in China are suffering from major transport problems, largely stemming from the growth in car ownership. This is causing major problems of environmental damage and congestion. Various policy interventions could reduce the growth of the impacts, but the situation will worsen as car use grows. Clearly, very bold measures will be required to prevent transport problems in Chinese cities from becoming overwhelming.

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