SHANGHAI'S NON-LOCAL VEHICLES AS A DILEMMA IN TRANSPORTATION POLICY TRANSFER FROM SINGAPORE

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ABSTRACT

Chinese cities have adopted many policy strategies internationally that have created many problems due to the differences in local context and institutional structure. In this paper we report an example of automobile license auction policy transferred from Singapore to Shanghai, and how a technical issue of non-local vehicles raised a dilemma for Shanghai government in the trade-off between congestion management and openness of Shanghai as a metropolitan center. The government sets up a total quota each month and requires every car owner to join a bidding process to obtain a vehicle license. As Shanghai license prices continue to increase, many Shanghai residents get a non-local license outside Shanghai for a much cheaper price. The problem of non-local vehicles is a unique phenomenon that only happens in Shanghai that waters down the policy effectiveness, and results in challenges in traffic management. It also results in large revenue loss outside Shanghai, exacerbates equity concerns among Shanghai car owners, and decreases trustworthiness of government policy. Singapore as a state-city has no non-local vehicles, but Shanghai as a city within a region, is facing the dilemma of further controlling non-local vehicles to mitigate congestion versus the city's openness to promote inter-city trade. Although Shanghai has taken actions in controlling non-local vehicles through both internal policy refinement and regional collaboration, it has hesitated in posing harsher restrictions. Public views vary across different dimensions and two variables show the largest impact on attitude: car ownership and license type, and residence status. The public do understand Shanghai's dilemma and the importance of the city to remain open as the public opposes further restrictions on non-local vehicles. Even local license owners and locally-born residents, who are most likely in favour of further restrictions, do not want harsh restrictions banning non-local vehicles.

Keywords: policy transfer, license auction policy, non-local vehicles, open city

1. INTRODUCTION

After decades of rapid economic growth, Chinese cities now face serious urban transportation challenges such as traffic congestion, air pollution, and energy shortage. Efficient and equitable transport policies are essential to sustainable development in China. Chinese cities have studied and adopted many policy strategies internationally. Driving bans in Beijing adopted from Mexico City (Wang, 2010) and the car license auction policy in Shanghai adopted from Singapore are examples of policy transfer. But the differences in China's local context, both institutional and structural, have created many problems in policy transfer from other nations. This study presents an example of policy transfer focusing on the license auction policy in Shanghai since it was the first city of China to implement a policy controlling car ownership.

On May 1st,1990, Singapore implemented a car quota scheme which required all purchasers of new cars to bid for car licenses through monthly auction (Koh and Lee, 1994). This was the first time for this kind of system to be implemented in the world (Phang, 1993). Shanghai adopted this car quota policy after visits of municipal officials to Singapore in the early 1990s (Wang, 2010). This policy was officially implemented in 1994 in Shanghai which was just four years after the first introduction in Singapore where careful evaluations of the effectiveness and local suitability could hardly have been done. The auction policy had similar effects in both Shanghai and Singapore on controlling vehicle fleet growth and generating government revenue. It also generates similar problems as the high license price causes affordable concerns, social equity concern of favouring the rich, and speculation activities such as car dealers and traders hoarding licenses (Phang, 1993, Chen and Zhao, 2011) There was one unanticipated phenomenon that only occurred in Shanghai: the large number of non-local vehicles on Shanghai's road.

The current price for a Shanghai license has gone over ¥50,000 (approximately $ 8,000 USD) (Shanghai Jinwei Automobile, 2011) which is more expensive than a small vehicle. This results in many Shanghai residents getting non-local licenses in nearby cities for much cheaper prices. Large amount of non-local vehicles driving on Shanghai's roads has watered down the effectiveness of license auction policy and resulted in large revenue loss from Shanghai. Based on our survey result, 36.5% of total car owners have non-local license and these vehicles are registered in different cities issuing the licenses which created even more problems in traffic management. Nearby cities has collaborated with Shanghai to increase the level of difficulty for Shanghai residents registering a non-local license (Yu and Hou, 2010), and Shanghai has posted peak hour restrictions (7:30 am - 9:00 am and 4:30 pm - 6:30 pm) on non-local vehicles driving on elevated roads. However, few studies have evaluated the effectiveness of these restrictions in controlling non-local vehicles and local residents' attitude towards non-local vehicles in Shanghai.

Singapore, as a city-state, is a closed system with no non-local vehicle problem. Shanghai, as one of the Chinese cities and metropolises, is an open city with continuous inter-city business and trading. The effectiveness of the city in controlling non-local vehicles is the key leading to successful implementation of the car ownership policy. Shanghai, as a city of China in the Yangtze River Delta, is surrounded by more than 10 cities with total population of more than 50 million people. With an open boundary to these neighbours,

Shanghai is facing the dilemma of enhancing policy effectiveness for congestion mitigation versus openness of the city for economic growth. The hukou relaxation in state government had resulted large inflow of migrant workers to big cities as Shanghai. The current floating population in Shanghai is over 11.2 million (National Statistical Bureau, 2011) which is 44% of the total population. Migrant workers are no longer a minority in Shanghai which makes non-local vehicle problems even more challenging.

Shanghai's non-local vehicle phenomenon is an unanticipated consequence of policy transfer. Evaluation of the policy restrictions on non-local vehicles, and better understanding of public attitude towards non-local vehicles are significant for local policy makers to improve the policy. As a result of policy transfer, this case study in Shanghai is also a good policy lesson to other Chinese or Western cities seeking opportunities for car ownership policy transfer.

Thus, the corresponding objectives in this study are to (1) compare license auction policy in Shanghai to its origin place in Singapore; (2) investigate the scale of and their consequences on non-local vehicles including challenges on local traffic management, revenue control, policy effectiveness and equity concerns; (3) discuss Shanghai's dilemma of congestion mitigation versus the city's openness and examine government's response through policy refinement and regional collaboration; and finally (4) use local survey data to evaluate public's attitudes towards the dilemma.

2. LITERATURE

Chinese cities investigated transport policies of other nations as they sought to solve China's traffic congestion problems. Car license auction policy is one example of direct policy transfer from Singapore. The following nine papers have provided insights to problems regarding transport policy transfers, and non-local vehicle phenomenon in Shanghai as an unintended consequence from policy transfer.

2.1 Policy Transfer

City to city policy transfer is a very active process in the field of transportation. However, not enough is yet understood about its benefits or the optimum conditions under which it is most effective. Such understandings would help to promote and accelerate the uptake of effective and well- matched policies.

Although not focused on transport policy, Marsden and Stead (2011) provided a thoughtful literature review on why and how transportation planning policies were transferred between cities by drawing lessons from policy transfers in the field of public policy such as political science. Marsden and Stead noted that policy lessons sometimes spread only based on the trust in the transferability of the policy between similar contexts. There was common thinking that policy solutions already existed in other countries and simply needed to be implemented more widely. They had pointed out the gap in the evaluation of policies transferred since few studies had traced policies through to implementation. This study also highlighted the importance of case studies in studying policy transfers and suggested that

negative policy lessons were equally valuable to the policy development process. Our study aims to fill this gap in the research of policy transfer by studying the non-local vehicle phenomenon in Shanghai as a case study.

To better examine transferred policies, Dolowitz and March (2000) developed a framework to examine the process of policy transfer. They suggested examining the "Why transfer" issue through the theory of bounded rationality which defines two important aspects. First, there are cognitive limits to the individual in terms of the choice sets that can be evaluated. Secondly, the environment that individuals are in affects the outcomes, which limit the range of options for the search. The choices people make are 'intended rational' within the limits of knowledge, context, uncertainty, timescales, and other constraints (Simon, 1956).

Marsden et al. (2012) confirmed this bounded rationality in policy search by evaluating the research conducted in the field of urban transport and planning policy across eleven cities in Northern Europe and North America. Their study seeks to explore the rationale for the search for new policies and the processes that city planners adopt in the field of transport planning and ways in which the search for policy lessons is bounded. Thirty policies were examined using document review and interviews with key actors. This paper suggested that the process of policy seeking and learning is defined by individuals operating within a particular policy space and show strongly bounded rational choice. They are significantly influenced by preconceptions of the nature of the preferred solutions and the likelihood of cities in other contexts offering meaning learning opportunities. Due to the large volume of information available and the quality often uncertain, key policy actors rely heavily on trusted peer networks to filter information and to learn from. The mobility of policies seems also to be linked to the mobility of the key transfer agents. This study suggests that despite the volumes of information available, the agents of transfer are critically important in how and why policies move. The key actor's influence on seeking policy lessons can also be seen in Shanghai's case as the license auction policy is quickly adopted after several visits of the Shanghai government agencies to Singapore.

Two recent papers below, by Attard and Enoch (2011) and Bray et. al (2011), showed example of using case studies in different countries to evaluate implementation of policy transferred from other nations using a model framework developed by Dolowitz and Marsh (2000). The framework considered the necessity of policy transfer, people involved in the policy transfer, and policy details transferred. It also included the origin city where policy lessons were learnt, degree of transfer, and constraints that transfer had occurred.

Attard and Enoch (2011) analyzed the implementation of road pricing in Valletta, Malta, and the role played by policy transfer in its introduction. In the first two years of policy development, the local committee of Malta studied the experiences with road pricing from London, Durham, Edinburgh and Stockholm through visiting and monitoring with respect to various aspects of road pricing policy approaches. They had noted that the timing of particular events and local situations were important for policy transfer to be successful using London as an example. Malta's case study suggested geographic proximity of locations was not the most important aspect, but instead, the economic, social, political and ideological context of the policy borrower and lender were more important.

Bray et al. (2011) examined the urban transport policy evolutions in the five largest cities of Australia: Sydney, Melbourne, Brisbane, Perth and Adelaide. This study was supplemented by observations from survey of public servants in the policy and strategy divisions of state and territory transport agencies. In line with Marsden and Stead (2011), Bray et al. also found that performance of previous strategies were not critically examined. There was also little evidence that the approaches transferred to states of Australia were superior to alternative approaches and were able to achieve the objectives set beforehand. This study noted the mismatch between views of policy professionals and politicians, where politicians seek action plans that could achieve specified outcomes, but professionals viewed strategies being important to present government aspirations for future urban transport.

Wang's (2010) paper focused more on China's context. He investigated congestion pricing, new plate quotas, driving bans, and park-and ride policies, and considered how these four policies might function in Chinese cities. For example, Wang compared Shanghai's car quota policy with the experience of such policy in Singapore. He noted that Shanghai's car quota policy failed to address the uncertain relationship between vehicle ownership and vehicle use. Secondly, Wang also mentioned that the effectiveness of license auction policy in reducing vehicle fleet growth depends on the extent to which a city could prevent residents from registering their vehicles with other non-local places. Unlike the city-state of Singapore, Chinese cities needed to place extra regulatory measures to control non-local vehicles and regional cooperation on the auction policy can be difficult. Wang concluded that the local context could significantly influence policy performance and must be carefully considered before any policy is implemented. Wang concluded that the auction policy was less effective in Chinese cities and could not eliminate the uncertainty of vehicle fleet growth due to the trade-off between local scheme and the mobility of vehicles. Wang's study was not specifically focused on Shanghai's non-local vehicles and only provided qualitative descriptions of the problems.

2.2 Non-local Vehicles in Shanghai

Previous literature on Shanghai's license auction policy only stated the general problems regarding non-local vehicles. None of the studies collected first hand data and investigated local residents' attitude towards non-local vehicles.

Hu (2004) stated several problems that Shanghai's car license auction policy was facing, including the large number of non-local vehicles, and Liu (2008) provided a thoughtful historical overview of Shanghai's license auction policy. Also, Lv (2009) had analyzed the policy effectiveness from an economic perspective. Although these three papers ended with different conclusions, they all had noted the large amount of non-local vehicles driving on Shanghai's road and paying taxes to non-local cities had caused large revenue loss outside Shanghai. Non-local vehicles, registered to the city of purchase, also led to difficulties with traffic management particularly during traffic accidents. Hu (2004) also mentioned that the proportion of non-local vehicles was largest among car owners with smaller or economy vehicles less than ¥100,000. Based on our survey results, 78% of the non-local license holders in our sample have small or economy vehicles. Local license holders, however, tend to choose more expensive and luxury vehicles.

Liu's (2008) study noted that license auction policy eased traffic congestion to some extent, and generated large revenues to spend on transportation infrastructure. In line with Hu (2004), Liu also suggested the policy reducing automobile sales caused negative effects on the economy. The high price of licenses in Shanghai led to speculative activities and car owners obtaining non-local licenses. Non-local vehicle license had formed an industry chain in Shanghai which attracted many car dealers and traders providing agent services. Liu concluded that Shanghai's policy encouraged more vehicle usage to counteract the high license price, partially offsetting the policy's effect. He also suggested that Shanghai should restrict vehicle usage rather than continue to restrict ownership.

Different from Hu's (2004) and Liu's (2008) opinions, Lv (2009) was optimistic about the effectiveness of the policy. Using traditional supply and demand theory, Lv noted that without government policy intervention, individuals would go for user optimum conditions to maximize use of the roads, which was not optimum for society. Shanghai's auction policy had suppressed the demand on vehicles that was effective in allocating scarce resource. He suggested that government would need to control the license price at a balanced market level and not so high as to force more car owners into getting non-local licenses, but also not too low as to be ineffective.

Previous studies specified that the government policy search process is limited and bounded. There is also often lack of careful policy evaluation after the implementation. The importance of case studies is also emphasized in previous literature on policy transfer. Literature focusing on Shanghai's policy also lacked quantitative data support and understanding of people's attitude was very limited. Thus, our study will fill the gap in transport policy research by evaluating Shanghai's policy as case study and collect first hand data to analyze public's attitude towards non-local vehicles.

3. METHODOLOGY

Two main methods used in this paper are document review and questionnaire survey. Government policy documents, literature, and newspaper articles are reviewed to examine license auction policy details in both Shanghai and Singapore, problems generated by large number of non-local vehicles in Shanghai and the government's response to the problems. Questionnaire survey is conducted among local residents to examine public response to the dilemma in both their attitude and behavior.

3.1 Data

This study will use data collected from a questionnaire survey conducted among Shanghai residents on public acceptance towards Shanghai's auction policy. Our survey focuses the employed population in Shanghai including both local and migrant workers. The employed represents the middle-class population who are well-off enough to consider having a car, but not too rich to disregard the cost of a license. They are likely the group most affected by the car license auction policy. But we acknowledge that such focus limits the study from being

generalized to represent the acceptance of the whole population, and particularly the unemployed and very low-income population.

We used two-stage sampling method: purposeful sampling for the selection of companies in Shanghai and random sampling for the selection of employees in the chosen companies. In the first stage, we selected nine companies varying in business type, location, size, and ownership (government and private).They included four engineering companies, two design companies, one research institute, one trading company, and one chemical plant factory. They were distributed from the central district (within the inner ring road) to the outskirts (outside the outer ring road), and ranged from 20 employees to 500 employees. Five of them are government owned and four are privately owned. The second stage uses random sampling to select employees in each company. In small companies with less than 200 employees, all employees were invited to participate. In large companies, 200 employees were randomly selected to participate. Overall we distributed 1,100 questionnaires to the employees in the nine selected companies in Shanghai.

The number of total responses collected was 827 with a response rate of 75% and overall sample of the questionnaire survey used for the study consisted of 524 participants after data filtering and cleaning of in-valid responses. The general characteristics of the sample skewed to relatively young, male, with higher education and household income due to the limitation in the sampling method. However, a variety of participants were included by selecting companies varying in business type, location, size, and ownership (government and private) to obtain a more representative sample. Please see Chen and Zhao (2011) for detailed description of the survey questionnaire design and sample characteristics.

In addition to the socioeconomic characteristics, the survey also measured participants' attitude towards the restriction on non-local vehicles from 2 aspects: effectiveness of the current restriction, and necessity for further restriction. Each attitudinal factor is measured using psychometric indicators which are further measured at five response levels: strongly agree, partially agree, neutral, partially disagree, and strongly disagree, coded 2, 1, 0, -1 and -2, respectively.

3.2 Model

This study uses Structural Equation Modeling (SEM) to better understand Shanghai people's view towards the current restriction on non-local vehicles and Shanghai's dilemma in posing further restriction. Structural equation models (Kline, 2010) are used to specify the causal relationship between proximal determinants identified with public attitude. The conceptual model contains two dependent variables and several explanatory variables. The key dependent variables are people's attitude towards current restriction on non-local vehicles, and necessity for future restriction. Explanatory variables include the observed variables that are directly measured as socioeconomic characteristics, car ownership and license types, location, and transit accessibility.

SEMs are implemented in the Mplus software (Muthén and Muthén, 1998-2010) which supplies maximum likelihood estimates based on covariance between the observed variables.

4. RESULTS

4.1 State-city (Singapore) vs. City in a Region (Shanghai)

In May 1990, Singapore introduced the Vehicle Quota System (VQS) which determined the number of new vehicles allowed for registration while the market determined the price of owning a vehicle through auction. It was the first time in the world for such policy to be implemented (Koh and Lee, 1994). The Shanghai government referenced the policy from Singapore in 1994 to dampen the car ownership growth rate in order for road infrastructure and public transit system to catch up (Wang, 2010). In both policies public auction is used for vehicle allocation and license auction also generates a large amount of government revenue. While Shanghai's policy originates from Singapore and still shares many similarities, it has also evolved and been fine-tuned after years of implementation that demonstrates enough differences from Singapore's.

Although both controlling vehicle ownership by setting up license quota, policies in Shanghai and Singapore differ in their methods and level of transparency in determining the car quota allowed. Singapore has a dedicated formula in calculating car quota taking into account the prevailing traffic conditions and the number of vehicles taken off the roads permanently (Land Transport Authority, 2012). All the quota information and updates in Singapore are published publically. Although Shanghai also announced it would calculate the quota based on road capacity (Shanghai Municipality, 2002), no detailed information is released on how car quota is determined.

One of the important differences between policies in Singapore and Shanghai is the amount of time owners are allowed to keep the license. Vehicle owners in Singapore bid for a Certificate of Entitlement (COE) through the auction that allows the holders to register a car for a period of 10 years, after which they must scrap their car or renew their COE. In order to keep the license, holders will need to pay a prevailing quota premium (average quota premium in last 3 months) to renew the license for further 10 years (Land Transport Authority, 2012). License holders can also choose to renew for 5 years by paying only half the amount of the prevailing quota premium, but a 5 year license cannot be renewed after. Different from Singapore, Shanghai's license obtained through the bidding is life-time and will not expire. Even after scrapping the car, Shanghai license holders are allowed to keep and register license to new vehicles within six months (China License Plate, 2011).

Although both policies use public auction to allocate car license, they also differ in the bidding format. Singapore categorized the auction according to five license types from Category A to E (Land Transport Authority, 2012). Category license A and B are for cars. License A is for small cars (<= 1600 cc) and taxis, and B is for large vehicles (> 1600 cc). Category C is for commercial vehicles and buses, while D is for motorcycles. In addition, Singapore also has Category E that can be registered to any vehicles. The quota allocated to each category is in proportion to that category's share of the total vehicle population. By having this sub-categorization, Singapore not only can control the total quota but also the proportion of vehicle types. Shanghai, on the other hand, only categorizes licenses to cars and motorcycles in the auction with no further categorization within cars.

Both policies result in a distortion in the motor vehicle market. Car buyers in both places move toward buying larger and more luxurious vehicles through the auction as the relative price of license plates became higher for smaller and less expensive vehicles (Wang, 2010). Since lower income people can afford only small vehicles, the auction policy is considered to be inequitable as favoring the rich. Larger vehicles also pose higher environmental impact. Although Singapore's sub-categorization tends to achieve fairer tax burden across income groups since quota premium for smaller vehicles is indeed lower than large vehicles, it's still not affordable to many lower income people (Land Transport Authority, 2012).

In terms of the bidding process, Singapore holds two auctions per month and each auction takes up three working days (Land Transport Authority, 2012). Singapore uses an Open Bidding System allowing bidders to submit the bid by keying in their reserve price, monitoring price and revising reserve price for the bid. The bidding price is updated in real-time and the reserve price is the maximum bid amount that a bidder is prepared to pay for the license. The bidding system will automatically revise the bid upwards until the reserve price of the bidder is reached. If the bidders' reserve price falls below the Current COE Price, the bidder is out of the running unless he revises his reserve price upwards. There is no limit to the number of revisions allowed. The Current COE Price will stop to rise when the number of bidders left equals the quota set up for that month.

Different from Singapore, Shanghai holds only one auction per month and the auction takes one day. Shanghai uses a two-stage bidding process. The first stage takes the initial bidding price from each bidder. The lowest winning price from all bidders in the first stage will be given and price adjustments are allowed in second stage. No price limit is set and bidders could bid any price in the first stage. In the second stage, up to two adjustments are allowed within ¥300 above or below the lowest winning price of the first stage (China License Plate, 2011).

Singapore and Shanghai's auctions also differ in the way bidders pay for the license. The latest Current COE Prices for each vehicle categories in Singapore will be set as the Quota Premiums and all successful bidders will pay the same Quota Premium for that category (Land Transport Authority, 2012). Unlike Singapore where all bidders pay the same price, Shanghai uses a pay as you bid system where all successful bidders pay the price they bid on. License quota transfers are banned in Shanghai but Singapore's Category C (commercial vehicle), and Category E license (an open license that can be registered to any vehicles) are transferable(Lee, 2009).

Affordability of the license is a concern in both places but the license price in Singapore is much higher than that in Shanghai. The current price for a Shanghai license is over $9,000 (Shanghai Jinwei Automobile, 2011) while the average quota premium for private cars in Singapore in April 2012 is over $60,000 for Type A cars(Land Transport Authority, 2012) which is seven times higher than that in Shanghai. The price for larger cars (Type B) or an Open license in Singapore is even higher ($90,000). Vehicles in Singapore are also more expensive. Singapore does not have domestic car industry and all the vehicles are imported. Controlling car ownership is harder in Chinese cities since the Chinese government is trying hard to boost domestic car industry.

Table 1 summarizes the comparison between policies in Singapore and Shanghai. Despite all these differences in the specifics as the policy evolves, the non-local vehicle is a unique phenomenon that only exists under Shanghai's policy. As a city-state, Singapore has no non-local vehicles although the license price is much higher than that in Shanghai, whereas Shanghai is a city of China with open boundaries to its neighboring cities. Many Shanghai residents get a license outside Shanghai to avoid the high license price. This results in revenue loss, waters down the theoretical effectiveness of the auction policy, exacerbates equity concerns, lowers trustworthiness of the government, and causes challenges in traffic management which is discussed in the section below.

TABLE 1 Vehicle quota policy in Singapore and Shanghai

	Singapore	**Shanghai**
Timeline	Introduced in 1990 First time in the world	Introduced in 1994 First and only city in China
Policy goal	Control car ownership level Generate revenue	Control car ownership level Generate revenue
Quota calculation	Released to the public	Not transparent
License useful period	First auction: valid for 10 years Renew (5 or 10 years) by paying prevailing quota premium	Life time
License category	Category A (car <=1600 cc) Category B (car > 1600 cc) Category C (commercial vehicle, bus) Category D (motorcycle) Category E (Open license)	Car Motorcycle (no longer available)
Transferability	Open category (Category E) and Category C are transferable	Non-transferable
Price	Over $60,000	Over $9,000
Equity concern	Favoring the rich	Favoring the rich
Bidding process	2 auctions per month Takes up 3 days Open Bidding System	Once per month Takes up 1 day Two-stage bidding
Auction outcome	All bidders pay the same price	Pay as you bid
Domestic car industry	No	Yes
Non-local vehicles	No	Yes

4.2 Shanghai's Challenges with Non-local Vehicles

As mentioned previously, many Shanghai residents get non-local licenses in nearby cities to avoid the high license price through the auction. Since license registration and annual vehicle check would need to be done in the city issuing the license, cities close to Shanghai in Jiangsu and Zhejiang Provinces are popular choices for Shanghai residents seeking non-local licenses.

The hukou relaxation in China allowed migrant workers to live and work in different cities with valid temporary residence permit that can be applied with current local residential address (Li and Wu, 2006). Non-local residents could apply to register vehicle license with temporary residence permit valid for at least 1 year (TrafficInfo, 2004). Thus, Shanghai residents can simply apply a temporary residence permit in non-local city in order to register a vehicle license there. This is also true for residents settling in other cities.

As Shanghai license price increases, more and more Shanghai residents choose non-local licenses for the much cheaper prices. Identifying the number of non-local vehicles in Shanghai is at first difficult as no formal statistics are available. Shanghai had once tried to conduct a census of the amount of non-local vehicles in 2004 (Jin, 2006), but it failed in implementation. Our survey result indicates 36.5% of the Shanghai car owners hold non-local licenses, which is a large proportion indicating significant penetration of non-local vehicles in Shanghai.

In order to control the total vehicle quota, city needs to be a closed system. To implement any transportation congestion management instruments, a city needs to be clear and precise on the demand they are aiming to control. But the base for Shanghai's transportation management is inaccurate with one third of the vehicles not counted in the system. This large number of vehicles missed in the system also waters down the theoretical effectiveness of the policy. The effectiveness of the policy is exaggerated if considering this large amount of "outsiders". Owners of non-local vehicles are also paying maintenance fees to these cities, resulting in large revenue loss outside Shanghai. Shanghai's annual road maintenance fee is ¥ 3,000 and car operation tax fee is ¥ 100 (USD $ 15) which adds up to an estimated annual revenue loss of ¥ 0.3 billion (USD $ 45 million) from Shanghai to other cites (Wu, 2004). This amount of revenue loss is already huge without including the revenue generated from the bidding in the auction and car insurance fees.

Looking past revenue loss, the high penetration of non-local vehicles also exacerbates equity concerns and loss of trust in government among Shanghai people. Non-local license holders who enjoy the same freedom of driving in Shanghai without paying the high license price, causes fairness concerns among Shanghai license holders. Large amounts of Shanghai residents getting around the auction policy to register non-local licenses also make government policy less trustworthy. As this group of people increases, more Shanghai residents are likely to follow suit, making the auction policy less useful.

In addition to that, Shanghai residents getting non-local license also cause challenges in traffic management. Since most of these Shanghai residents do not live in non-local cities and the addresses provided on their temporary residence permit are made up, accountability and responsibility during traffic accidents becomes difficult. Also, Shanghai residents with non-local vehicles violating regulations such as speeding cannot be fined as there is nowhere for the tickets to be sent (Yang, 2008).

4.3 Government Response

In response to the challenges generated by the large amount of non-local vehicles, Shanghai government must both collaborate with nearby cities and fine-tune its own policy to control non-local vehicles.

During the meeting of vehicle management department among 15 cities from the Yangtze River Delta districts in Shanghai in 2004, cities came into agreement setting up a traffic management information communication system and ensuring local vehicles are registered by local license (TrafficInfo, 2004). The main objective of the meeting is not to collaborate with Shanghai but to enhance communication between cities for better traffic management. Still, many local restrictions helped limit Shanghai residents registering licenses in these cities. The general restrictions in nearby cities in Jiangsu and Zhejiang Provinces are designed to raise the difficulty in temporary residence permit registration for Shanghai residents.

Shanghai has also taken actions in controlling non-local vehicle registration by allowing vehicles purchased in Shanghai car dealerships to be only registered with a Shanghai license. This is also valid for non-local residences in Shanghai formally starting from 2009 in order to protect the local car market (Zhou, 2009). In terms of usage, Shanghai has banned non-local vehicles driving on elevated roads during rush hour (Jin, 2006). These elevated roads are expressways to speed up the traffic on surface roads. Restrictions on using elevated roads are inconvenient for non-local drivers but they can still drive on surface roads underneath. Figure 1 below highlights the restricted elevated roads (in red) banning non-local vehicles in the city. Non-restricted elevated roads are highlighted in blue. Only the Outer Ring Road is excluded and most of the restrictions are in the central city (Middle Ring and Inner Ring Road). Non-local vehicles violating this peak hour restriction face ¥200 fines and mark 3 credits on their drivers' license. Enforcement is done by installing electronic cameras on elevated road to catch violating vehicles in 2011 (Sun, 2011). Other than this, Shanghai had kept this compromise on peak hour restrictions for several years without further restrictions.

FIGURE 1 Peak hour restricted elevated roads for non-local vehicles (Shanghai Municipal Public Security Bureau, 2011)

A city's capacity in controlling non-local vehicles is the key to successful implementation of car ownership policy. As one of the leading cities in China, Shanghai has the capacity and power to pose harsher restrictions, yet Shanghai has hesitated to step forward. By posing further restrictions, Shanghai would have to sacrifice its openness as a city that is one of the most important features for maintaining city competitiveness (Clark, 2010). An open city could create a labor pool in supporting public infrastructure and services, attracting different skill sets to boost the city economy in different sectors, fostering economic internationalization and specialization, and attracting innovators, investors, visitors, and residents. Also, openness of a city needs to be two-way, having low barriers of entry and exit (Clark, 2010). Shanghai's debate around openness is not only a local issue, but also a conflict with other cities. Closing Shanghai's boundary to outsiders may also affect nearby cities. Thus, the art of balancing congestion mitigation versus openness as a city has made non-local vehicle management more difficult. Further restriction may also raise public concern given the high penetration of non-local vehicles already in Shanghai. However, previous government restrictions do not offer a full solution to the non-local problems but instead result in a type of business chain in Shanghai.

4.3 Market Response

As the demand for non-local license increases among Shanghai residents, many car dealerships started to provide services in registering temporary residence, getting non-local license and doing annual vehicle check for their Shanghai customers for a certain amount of service charge (Jin, 2006). The services provided by car dealers make getting non-local vehicles more convenient, further encouraging more Shanghai residents getting non-local licenses.

As a result of nearby cities increasing restrictions on non-local vehicle registration, service charges for car dealership also increased. Service charges in getting car license by dealership initially cost only ¥ 1,000 but quickly increased to ¥ 4,000 after these restrictions (TrafficInfo, 2004). Suzhou is among the most difficult cities to get license as it requires not only a temporary residence permit but also requires other documents such as proof of work, proof of housing purchase, or a business license (Wu, 2004). In response to the restriction, car dealers extend their services to cities farther away from Shanghai such as Anhui and Shandong Provinces with looser control on non-local license registration. Some even got license from Inner Mongolia which is at the north edge of China (Ye, 2012). The current service charges provided by one of the Shanghai car dealerships for a Jiangsu license for Shanghai residents cost ¥ 9,200 which is almost a quarter of the ongoing price for a Shanghai license (Shanghai Jinwei Automobile, 2011). Even the price for cities farther away in Shandong cost ¥ 4,500.

4.4 Public Response

4.4.1 Overall attitude

In addition to the market and government response, how Shanghai people view the controls on non-local vehicles and Shanghai's dilemma is also important. Table 2 shows the two attitudes investigated including views about effectiveness of current restriction and enforcement. Shanghai people's attitude towards the dilemma can be reflected in their attitude towards the necessity for further restriction on non-local vehicles. Indicator statements used to measure each attitudinal factor, percentage of responses, and Cronbach's alpha value for each attitudinal factor are shown in the table.

Overall, Shanghai people think the current restriction on non-local vehicles together with the enforcement is already effective. As mentioned previously, violating the peak hour restriction results in a ¥ 200 fine with 3 credits deducted from the driver's license. Driver's license will be taken away if the driver loses all 12 credits. The driver will then be forced to learn lessons on road safety regulations, and pass the knowledge test to renew his driver's license (Driving School Information, 2012). Although ¥ 200 fine seems to be small comparing to the expensive price of a Shanghai license, the credit penalty does make it inconvenient for non-local drivers. The peak hour restriction is further enforced by installing electronic cameras on elevated roads and over 60% of the participants feel the penalty and enforcement to be effective.

Facing the dilemma of congestion mitigation versus openness of the city, Shanghai government has kept a compromised peak hour restriction. Given the high penetration of non-local vehicles in Shanghai, we also ask people's attitude towards the dilemma as to if it is necessary to pose further restriction on non-local vehicles. In terms of further restrictions, there are two paths the government can follow: totally ban non-local license registration or ban non-local vehicles entering Shanghai. In general, Shanghai residents do not feel it's necessary to totally ban non-local vehicles, and more people oppose banning non-local vehicles driving in Shanghai compared to non-local license registration. Majority of the people do recognize Shanghai as a metropolis should be more open to other cities.

Table 2 Indicator statements measuring public attitudes towards non-local vehicles in Shanghai

	Statement			
Sign	**Effectiveness of current restriction**	Strongly/partially agree	Neutral	Strongly/partially disagree
+	I1 - Cars with non-local licenses driving on elevated road during rush hours would be fined ¥200, which would effectively reduce the amount of non-local vehicles on elevated road.	60%	20%	20%
+	I2 - The Traffic Control Photographic Systems installed can effectively reduce the number of non-local vehicles driving on elevated road during rush hours.	61%	23%	15%
	Further restriction on non-local vehicles (Cronbach's alpha = 0.69)	Strongly/partially agree	Neutral	Strongly/partially disagree
+	I3 - Shanghai should cooperate with nearby cities to totally ban Shanghai residents registering non-local vehicle licenses.	36%	20%	44%
+	I4 - Shanghai government should totally ban non-local vehicles driving on Shanghai's road.	25%	18%	57%
-	I5 - As a metropolitan, Shanghai should welcome vehicles from other cities to enter and drive freely in Shanghai.	53%	28%	19%
-	I6 - Shanghai should lose the restriction on non-local vehicles since it has a lot of trading with other Chinese cities.	54%	27%	19%

4.4.2 Attitude variations

In order to better understand public attitude, we further segment the population along three dimensions to identify any attitude variations: car ownership, socioeconomic characteristics, location and transit accessibility. Among all independent variables, two show the most significant variations: 1) current car ownership and license types; and 2) participants' residence status.

Shanghai people's attitude towards effectiveness of non-local restrictions varies largely among car owners. Shanghai car owners, who bid for their car license through the auction, think government's peak hour restriction and enforcement as the most effective compared with others. In contrast to that, non-local license holders actually feel the exact opposite way. This could be because people who think of the current restriction as effective will be more likely to choose a Shanghai license to avoid the inconvenience in driving non-local vehicles. However the government's current response to non-local vehicles does not seem to be effective as viewed by the non-local license holders and Shanghai's government kept this compromise for years without further action. This peak hour restriction may not have any impact on people who do not need to travel in peak hour or have no need of using elevated roads. Also, the majority of the restricted elevated roads are within the Outer Ring Road as shown in Figure 1 above, and those living outside of the Outer Ring Road will be less affected by the restriction.

In addition to attitudes towards the current restriction, we also ask people's view on the dilemma Shanghai currently faces: should Shanghai government enforce the auction policy by totally banning non-local vehicles or should it loosen the restriction to promote more inter-city trade for openness of the city? Car ownership and license type again shows significant variations and two key findings can be seen. First, non-local license holders' opposition towards further restrictions is the strongest as they will be mostly affected by. Secondly, even Shanghai license holders, who are most likely in favor of further restrictions, do not want to totally ban non-local vehicles. Our initial hypothesis is a large amount of non-local vehicles in Shanghai not only waters down the policy effectiveness, but also exacerbates equity concerns among Shanghai car owners. Yet based on the results, despite the equity concern, Shanghai car owners do understand the dilemma the Shanghai government faces and the importance of a city to remain open.

People's residence status also shows significant and interesting variations in the two attitudes. Locally born residents feel the current restriction to be more effective than migrants, but as migrants live longer in Shanghai (> 10 years), their attitude gets more positive and are even higher than local residents. Migrants' opposition towards further restriction is stronger than local residents despite the variation in attitudes among migrants living over different periods of time in Shanghai. This is true even for migrants who have lived more than 10 years in Shanghai.

As Table 4 shows, the percentage of non-local license holders among car owners is the largest among migrants especially those who have lived for less than 10 years. One possible explanation is migrants may already have non-local vehicles and further restrictions will obviously affect their travel in Shanghai. This also implies that even after the migrants have settled down in Shanghai for years, they still feel less connected to Shanghai than locally born residents. Given the large number of floating population in Shanghai, problems with migrants may be challenging for Shanghai government in posing further restrictions.

Secondly, migrants living in Shanghai for longer than 10 years show less opposition to further restriction compared to those residing in the city for a shorter period of time. Surprisingly, migrants who live for 5 to 10 years in Shanghai show the strongest opposition. Migrants are floating population and many of them do not have Shanghai hukou. Without a hukou in Shanghai, they cannot share the same social and medical benefits as local

residents do. Their children cannot even attend school in Shanghai which makes them feel less connected. As they stay longer, many migrants are able to obtain a Shanghai hukou, buy cars and houses, and finally feel settled down.

Table 3 Attitude variations towards non-local vehicles according to socioeconomic, household structure, location and transit accessibility characteristics

Variables		Sample (%)	Effectiveness of current restriction	Further restriction
car ownership and license type	Have no car	58%	0.27	-0.41
	Local car owners	27%	0.63	-0.04
	Non-local car owners	15%	-0.02	-1.03
	p-value		0.00	0.00
Residence status	Migrants live < 5 years	31%	0.11	-0.51
	Migrants live 5 – 10 years	14%	0.24	-0.59
	Migrants live > 10 years	21%	0.61	-0.35
	Locally born in Shanghai	34%	0.46	-0.24
	p-value		0.00	0.01

Table 4 Car ownership distribution with different residence status

Car ownership and license type		# of car owners/total population	NL license holders /car owners
Residence	Live < 5 years	8%	57%
	Live 5 - 10 years	5%	41%
	Live 10 years +	14%	28%
	Born in Shanghai	16%	28%

Even when other variables are controlled, car ownership and residence status still show a significant impact. Using structural equation models, Figure 2 illustrates the impact of people's characteristics on the two attitudes (only variables significant at 95% confidence level are shown). Attitude towards effectiveness of the current restriction is shown correlated with support for further restriction (causal path shown in double headed arrow). Car ownership and license type shows significance in both attitudes. Compared to non-car owners, having cars with Shanghai licenses has a positive impact on effectiveness of the current restriction and these people also are more willing to accept further restrictions. Having cars with non-local licenses, on the other hand, has a negative impact on belief in the current restrictions and non-local license owners do not want further restrictions. Being migrant workers also show significant negative impact on effectiveness of the current restriction.

In addition, participants who are male are less amenable to further restrictions. Interestingly, other variables which we expected to have impacts on people's attitude, like education level and household income, do not show significant differences. This implies that despite ones' socioeconomic characteristics, people's residence status and car ownership and license types show more impact on their attitude towards non-local vehicles.

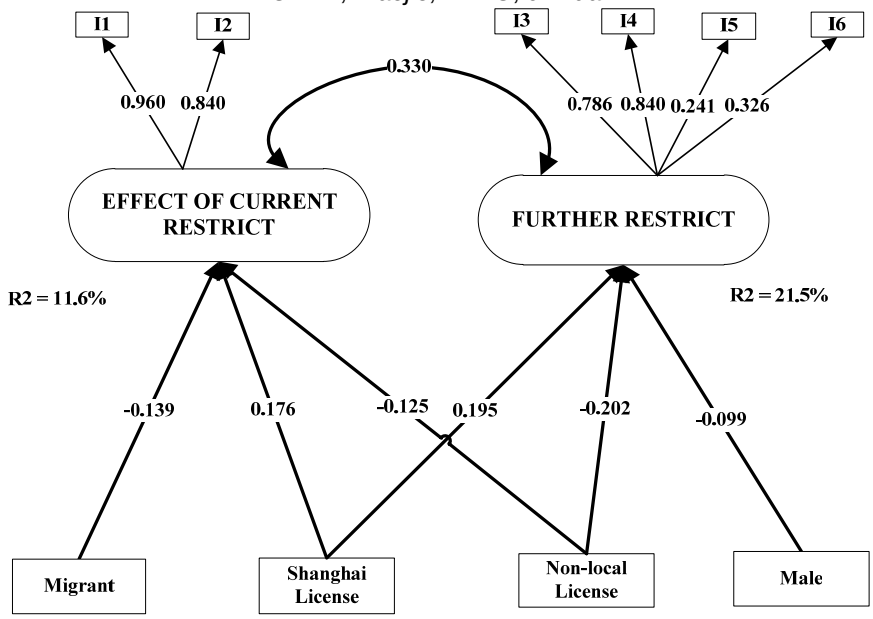

FIGURE 2 Structural equation models on attitude towards restriction on non-local vehicles (variables show are significant at 95% confidence level)

Not only car ownership and people's residence status shows largest significance on attitude, their attitude also varies significantly within the group. Figure 3 graphs the mean attitude among local and migrant residents with different car ownership and license types. Three findings could be summarized:

1) Both attitudes do not vary significantly for Shanghai license holders no matter if you are local or migrant residents.
2) Residence status shows significant variation in attitudes among non-car owners. Local residents with no car think the current restriction as more effective, and they show relative support for further restriction on non-local vehicles.
3) With non-local licenses, residence status also shows significance. Migrant workers having non-local licenses, local residents do not think the current restriction is effective and they also show strong opposition towards further restriction. Migrants, however, are more willing to accept further restriction.

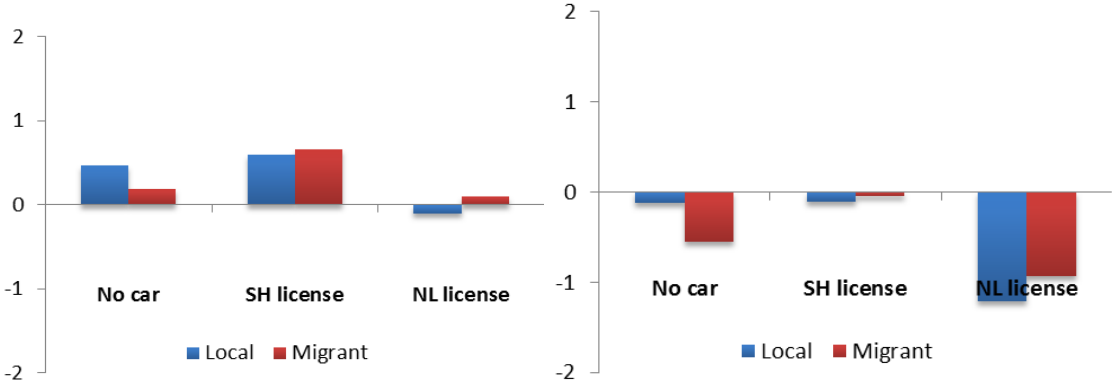

FIGURE 3 Attitude variations towards effectiveness of current restriction (LEFT) and support for further restriction (RIGHT) among local and migrant residents based on car ownership and license types

5. DISCUSSION

Shanghai adopted the auction policy in early 1994 just four years after its introduction in Singapore. Through years of implementation, the policy in Shanghai has become fine-tuned and differentiated from Singapore's auction in order to suit local context. While both policies have similar goals of controlling car ownership and generating government revenue, they differ in many aspects of the implementation process. Both use public auction in allocating vehicle license, but Singapore's policy is more transparent in its quota calculation. Although both policies cause equity concerns favoring the rich, Singapore's auction achieved a relatively fairer tax burden across income groups by sub-categorizing the license. Singapore's policy is also stricter comparing to Shanghai, as it only allows license holders to keep their license for 10 years initially and renewable only after paying the premium again. Vehicles and licenses are also much more expensive in Singapore compared to Shanghai. Yet even with much higher cost for a license, Singapore has no problem with non-local vehicles, as happens under Shanghai's policy.

Singapore, as a city-state, has no non-local vehicles and nor does it have a local car industry. Shanghai, as a metropolis in China, has open boundaries with its neighbors and continuous inter-city trading. Comparing the auction policies in Shanghai with its origin nation, the phenomenon of non-local vehicles in Shanghai is an unanticipated consequence of policy transfer from Singapore. Penetration of non-local vehicles is not only high based on our survey result (36.5%) but also unknown. This amount of cars driving in Shanghai is not captured by city statistics which is the first step required in order to manage it. This largely waters down the theoretical effectiveness of the auction policy in Shanghai and results in large revenue loss outside Shanghai every year. Despite the traffic management problems generated by large amounts of non-local vehicles, it also exacerbates equity concerns among car owners and decreases the trustworthiness of government policy. A city's capacity in controlling non-local vehicles is the key to successful implementation of car restraining policy. In order to fully control non-local vehicles, Shanghai needs to trade-off in openness as a city, thus reducing inter-city mobility and trading.

In response to the challenges with non-local vehicles, the Shanghai government has taken action in both region collaboration and internal policy refinement to manage non-local vehicles. Nearby cities have raised restrictions on temporary residence registration for Shanghai residents. This raised barrier s is also reflected in the increasing service charges for car dealership services of getting non-local licenses. Shanghai also controls non-local vehicles in both license registration and usage. Shanghai government requires Shanghai vehicles to be only registered by Shanghai license to protect local car market. Shanghai also poses peak hour restriction to ban non-local vehicles on elevated roads during rush hour.

Shanghai's peak hour restriction has been implemented for years, but the effectiveness is hard to measure as can be seen from the large penetration of non-local vehicles in Shanghai. Shanghai's government could further limit non-local vehicles but this poses significant enforcement challenges: how to identify non-local vehicles, and much more difficult, how to differentiate non-local drivers with legitimate business in Shanghai from those Shanghai residents escaping the auction policy. Although Shanghai has the technology and institutional capacity to strictly enforce the policy, it cannot simply shut its door. As a

metropolitan area, Shanghai has continuous business with other cities and it is the biggest trading center in China. This dilemma of the congestion mitigation versus openness as a city of a state has made the non-local vehicle management very difficult. Although many rumors had come out over the years speculating on the government's decision to further control non-local vehicles, Shanghai has continued to keep its current compromise without stepping further. More restrictions may endanger the openness of the city and Shanghai's competitiveness among other cities.

Public's attitude towards the current restriction on non-local vehicles and Shanghai's dilemma for further restriction are measured. The majority of participants think the current peak hour restrictions, fines, and enforcement are effective except non-local license owners. In terms of the dilemma, people do not want further restriction that would totally ban non-local vehicles. Majority of them do understand the current dilemma of congestion mitigation and openness of the city Shanghai is facing. People's attitude varies among different groups, but people's car ownership and license types together with their residence status show more significant impacts on their attitudes than their socioeconomic characteristics such as education and income. Although local license owners' attitude is relatively neutral, they still do not want the government to totally ban non-local vehicles. Migrants' opposition towards further restrictions is also stronger than locally born residents and they want the city to be more open.

Shanghai resident's attitude varies significantly not only according to their residence and car ownership, but also within the groups. Local residents, who are theoretically more likely to favor further restriction, show significant and negative attitude. While migrant residents, who should be opposing further restrictions, are more willing to accept strict restrictions once they've obtained a Shanghai license. Non-local vehicles in Shanghai offer a good example of the unanticipated consequences of policy transfer. The balancing art of how to manage non-local vehicles is one key factor to the policy success. Parking charges may be a supplemental policy to consider if Shanghai government wants to raise the barriers on nonlocal vehicles. Local residents living in Shanghai would need to find dedicated parking lot for their vehicles. Parking is a good way to identify the nonlocal license holders who live in Shanghai and differentiate from the travellers and those who live in Shanghai for a short period of time for business purpose. In addition, since cost is one key concern that leads many Shanghai residents choosing nonlocal license, having different parking charges for local and nonlocal vehicles would be an option to increase cost of owning nonlocal vehicles which would instead deter some potential nonlocal license buyers. Moreover, our understanding people's license choice was mainly based on the financial ability. However, license choice may be a complex process that other factors may have significant impact such as people's respect of government regulation, their social image concern for local and nonlocal licenses, Furture research may include using parking as a way to control nonlocal vehicles and develop a logit model to exmine the factors contributing to Shanghai residents' license choice decisions.

ACKNOWLEDGEMENTS

We would like to thank the following companies in participating in this research: Rongsheng Heavy Industry, Engtek International Trading Ltd., Shanghai Waigaoqiao Shipbuilding, Shanghai Maric Marine Design and Research Institute, Shanghai Petroleum and Chemical Equipment Corporation Ltd., Changxing Island Shipyard, China Shipbuilding NDRI Engerring Co., Ltd (CSSC), Ninth Design and Research Institute of CSSC, Shanghai Zhongjian Architectural Design Institute Co., Ltd. We also thank Yan Jiang, Qiang Chen, and Yan Zhu for their generous help in implementing the survey in Shanghai.

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