***WHO CARES ABOUT THE FUEL EFFICIENCY? EVIDENCES BASED ON CHINESE AUTOMOBILE REGISTRATION DATA***

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## Overview

## Analyzing the change of automotive fuel efficiency in China is important for estimating the impacts of China’s expanding demand for cars on international fuel prices and CO2 emissions. From 2005 to 2011, car sales increased by 336% in China and now more 10 million cars are sold there per year. Given these large sales, whether car fuel efficiency technologies are available and adopted in China is critical for concerns about both environmental quality and energy sufficiency (Schipper and Ng, 2004; Huo et al., 2011). However, the fuel ues of car owners increase far slower than the car sales. From 2005 to 2011, the number of private cars on the road increased from 18.48 million to 73.27 million. In contrast, the motor gasoline consumption in China only rose 55% in the same period. The difference between increase rate of car ownership and that of the gasoline consumption indicates that consumers’ preferences regarding fuel efficiency have fundamentally changed in China.

## The recent growth of China's automobile industry has been tremendous. Due to the pressure from climate change and dependence on fossil fuel, in 2004, China adopted a Chinese Car Fuel Consumption Standard (CCFCS) and promulgated a tax reduction policy to the cars whose displacement are less than 1.6 Liters (Tax Credit to Small Displacement Cars, TCSD). The CCFCS establishes maximum allowable fuel consumption limits for vehicles divided into 16 weight classes. Phase 1 was implemented on July 1st, 2005, for new models, and July 1st, 2006, for continued models; Phase 2 was implemented on January 1st, 2008, for new models, and will be implemented January 1st, 2009, for continued models. The TCSD reduced the consumption tax rate for small displacement cars to 5% in 2009 and the rate raise to 7.5% in 2010. In 2011, the tax rate for small displacement cars raise back to normal rate, which is 10%.

## New research frameworks need to be established because China’s car market differs from other markets not only by its growing rate but also because of its unique structures and regulations. In contrast with the protection of domestic companies from foreign competitors, a policy that broadly used in other national markets, China encourages joint ventures. As a consequence, the Chinese market is dominated by foreign car models. In addition, the CCFCS is essentially different from the Corporate Average Fuel Economy (CAFE) standard of the United States (Wagner et al. 2009). Because of such differences, the results from literature on other national markets cannot be directly used to deduce the performance of China’s automotive market. However, owning to a lack of data, China’s market has not been rigorously studied and the effectiveness of policies have not been evaluated.

## By coordinating data from different sources, we have compiled a dataset that includes the market information and technical details of all car models sold in China between 2005 and 2011. In addition, the dataset also includes information about factors that affect consumers’ cost for operating cars, such as the index of transportation congestion and fuel price. According to the estimation of our early work, the technological progress of automotive fuel efficiency in China has clarified the availability of fuel-efficiency technologies. In this paper, we examine the consumers’ preferences and car companies’ strategies regarding the technologies related with fuel efficiency. From the analysis, we clarified whether consumers or car companies are the main drives to improve cars’ performance of fuel efficiency in China.

## In this paper, we analyze the factors that drove China’s automotive fuel efficiency by establishing a theoratical model and estimate the effects of the factors by a structural econometric model. This paper is organized as follows: After the introduction, the theoretical and empirical models are presented in second 2; Section 3 includes the description of data source and basic statistics; In section 4, we discusses empirical strategies and econometric models. Section 5 presents summarizes all the papers.

## Methodology

The movement of automotive fuel efficiency technologies in China is a result of the marke equlibrium which determined by the interaction between car suppliers and consumers. On the supply side, we assume a car company determine its optimal strategy by solving

$$\max\_{\left\{p\_{i}\right\}\_{i\in f}}\sum\_{\left\{i\in f\right\}}^{}p\_{i }q\_{i}\left(p\right)-c\_{i}\left(q\_{i}\left(p\right),Γ\_{i} \right) $$

$$s.t.Γ\in Φ$$

Here, $i$ is the index of model, $f$ is the index of company, $p\_{i}$ is price of model $i$ and $q\_{i}$ is quantity of model $i$. $Γ$ is a vector including technological features of all car models belongs to company $f$. $Γ\_{i}$ is the vector including the technological features of of model $i$. The feasible set of $Γ $is $Φ$, which is determined by the feasible technological set for company $f$ and regulations. We assume a car company make its optimal decision yearly.

 On the demand side of the structural model, the consumers’ preference for fuel efficiency with respect to other attributes will be analyzed by using discrete choice models, in particular, the Berry-Levinsohn-Pakes model (BLP model). The fuel cost to consumers for using cars are derived from Beijing’s Annual Travelling Survey.

To discuss the effectiveness of the CCFCS and TCSD for improving fuel efficiency, the effect of the CCFCS and TCSD are compared with that of some counterfactual policies, such as CAFE standard scenario and fuel tax scenario. The effect of counterfactual policies will be simulated based on the estimated parameters. These conclusions, in turn, lead into a proposal for the design of future fuel-efficiency policies.

## Results

1.Increasing of fuel costs significantly incentivize consumers’ preference move towared fuel efficient cars and this movement encouraged car companies to improve fuel efficiency of cars. By a further analysis, we argue that longer travelling time rather than longer travelling distance drove the movement of consumers’ preference.

2. However, consumers in China trended to consume larger and larger cars. As a consequence, the effects of fuel efficiency improvmenet on total motor gasoline are offsets by the consumers’ preference for larger cars.

3. The policies slightly but statistically significantly encouraged the fuel efficiency improvmenet in China’s automobile sectors. However, their effectiveness varied to cars with different technological features. For cars with displacement less than 1.6 Liters, one Chinese Yuan spend in CCFCS corresponded to 0.071 liters less fuel consumption for driving 100 Km and the effectiveness for TCSD is 0.086 leters per Yuan spending. However, the cost effectiveness of CCFCS for cars with dispalcement larger than 1.6 Leters is only 0.022 leters per Yuan spending and not significant. The effectivness of CCFCS and TCSD are better than the simulated results of CAFÉ scenario but worse than a scenario with a optimal fuel tax.

## Conclusions

The longer tranveling time, which was caused by congestions, force consumers to purchase fuel efficient cars, and this trend of aggregated consumptions encouraged car companies introduce more fuel efficient cars into China’s market. The policies implemented by China’s government had slightly but significiantly positive effects on the movement of technological frontier regarding fuel efficiency. We suggest China to stringent their fuel consumption standards for heavier cars with considering more consumers trend to consume heavier cars and the effectiveness of current CCFCS is poor for large cars.

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