Introduction

- Transportation sector should be the most important industry which needs to address the carbon emission reduction problems.

- Different countries have chosen different policy toolbox.
  - US: CAFE requirements based on footprints.
  - China: Model level fuel efficiency standards based on curb weight plus CAFC (Corporate Average Fuel Consumption) requirements.

Background

- Existing studies have discussed the distortion of incentive caused by the loopholes of attribute-based CAFE requirements, which allows car producers to manipulate the curb weight and consider a variety of products in production plan rather than improve the efficiency directly for meeting the enforced standards.

- China has a long history of attribute-based model level fuel efficiency standards since 2005 represented by GB19578-2004 with its updated version as GB19758-2014.

- In 2012, China had its own flat CAFC requirements of 6.9L/100Km (equate to 34 mpg) by the introduction of GB27999-2011 which targeted at 2015 and the updated version as GB27999-2014 targeted at 2020 in 5L/100Km (equate to 47 mpg).

Results

1. When model level attribute-based standards were introduced during 2005-2011.
   - During Phase I and II, car manufacturers have no incentive to promote the fuel efficiency except for compliance considerations.
   - Model level attribute-based standards limit the ability of manufacturers to improve fuel efficiency by downsizing curb weight, instead of requiring them to make improvements in the products by change the attributes except for curb weight that are correlated with fuel efficiency.

2. When CAFC was introduced and got tightened over time.
   - China’s CAFC system have no trading opportunity for the extra credits earned by manufacturer during 2012-2016.
   - Although the corresponding fuel consumption level get tightening over time, the curb weight interval partition never changed. So manufacturers have the incentive to increase the curb weight to meet the regulation as indicated in Figure 2. But as CAFC target is gradually shrinking to 5L/100Km at 2010, Figure 3 indicated that it’s really not easy to reach that. Especially for those manufacturers whose production level over 500000 per year. They can’t meet the requirements of CAFC (leftmost red vertical line) with the same production plan in 2017.

Data & Model

- Data are extracted from MIIT website. MIIT announcements about the new registered cars will be issued every month. The time frame ranges from 2005 to 2017, covering the fuel efficiency standard Phase I, II, III and IV. The data includes each vehicle’s model year, model name, fuel type, manufacturer, engine type, transmission type, curb weight, fuel economy, and wheel drive type.


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\max_{\theta, p_{ij}, q_{ij}} \pi = \sum_{i \neq j} (p_{ij} - c_{ij})q_{ij}
\]
\[
s.t. \ g_j \leq \sigma(a_j) \ for \ j \in J
\]

- Theoretical model for Phase III and IV (2012-2020):

\[
\max_{\theta} \pi = \sum_{i \neq j} (p_{ij} - c_{ij})q_{ij}
\]
\[
s.t. \ g_j \leq \sigma(a_j) \ for \ j \in J
\]

\[
and \ \sum_{i \neq j} q_{ij} g_j \leq \theta
\]

- When \( \theta \neq \sum_{i \neq j} \frac{q_{ij}}{\sigma(a_j)} \), the constraints faced by one firm with CAFC is not identical.

- The CAFC target setting and its relationship with the model level attribute-based standards are crucial.

- Proposition 1: Choosing the median strategy for CAFC setting (with trading) is a strategy-proof mechanism and will minimize the social cost to make greener cars.

Conclusion

1. Model level attribute-based fuel efficiency standards not always valueless. They could be efficient as a reflection of technology cost curve related to the utility function and the size of the externality.

2. When CAFC is introduced, it must be added with trading system to incentivize the car manufacturers to promote the fuel efficiency otherwise its policy impacts will not reach expectations.

3. China’s fuel consumption target seems too radical. Although the trading system for CAFC credits was addicted in 2017, many manufacturers are still facing great difficulties in reaching the target. They appear to have no choice but to produce BEV cars.

References
