Targeting of Fuel Efficiency Programs in China's Automobile Industry

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Motivation: Subsidizing Fuel-Efficient Cars

- To reduce gasoline consumption and carbon dioxide emissions in China:
  - a national cash subsidy program for fuel-efficient cars from 2010 to 2013
  - must have an engine size less or equal to 1.6 liters to be eligible
  - each consumer received a 3000 RMB cash subsidy when he/she purchased an eligible car
  - provided 12 billion RMB subsidy on fuel-efficient vehicles by the end of 2011
- In Chen, Hu, and Knittel (2017), we show that the program was not cost-effective in reducing carbon dioxide emissions

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Our research questions in the present paper:

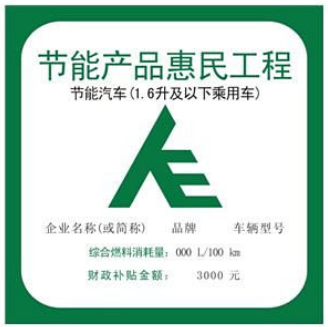
1. Who bought inefficient vehicles?
2. How well did the program target "biased" consumers?

A Thought Experiment

- Our approach: exploit individual level attributes
- Group of consumers: consumers with similar attributes (age and gender) demanding similar cars
    - example: 30 year old males living in a specific county buying a mid-size SUV
- Expected fuel inefficiency of all consumers demanding vehicles with similar attributes
- Bias: conditional on buying a vehicle, the difference between the observed and the expected average fuel inefficiency for a group of consumers
- Goal #1: find consumer attributes that correlate with the highest fuel inefficiency
- Goal #2: show how a subsidy program changed the distribution of the bias

The Cash Subsidy Program

- One of the many national programs that aim to promote energy-efficient products
- Provided a one-time 3000 RMB cash subsidy to consumers who purchase government certified fuel efficient vehicles
- A car dealer must affix an official program sticker to the side window of an eligible vehicle at display
- The government reimburses car manufacturers on a monthly basis

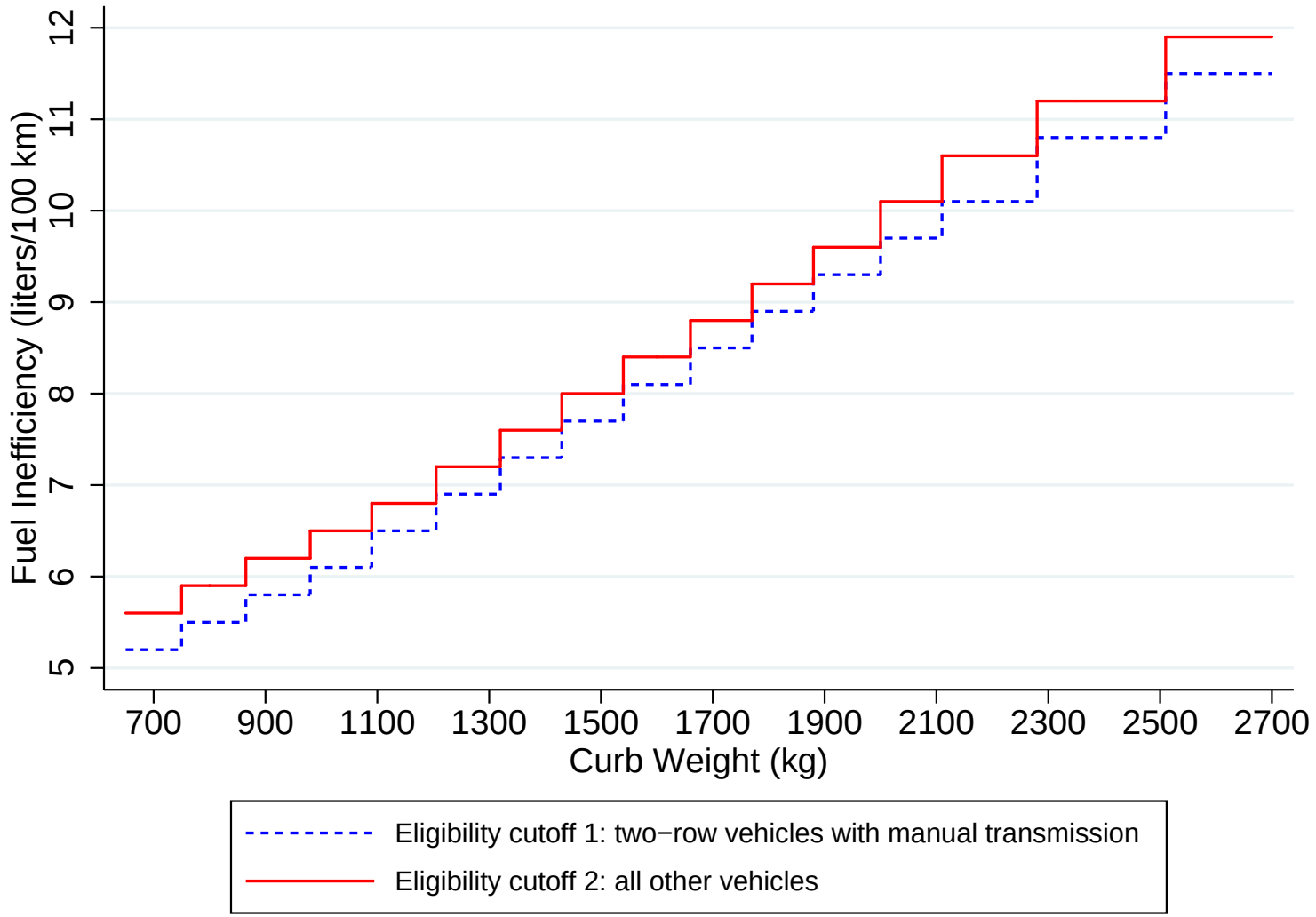


Program Eligibility

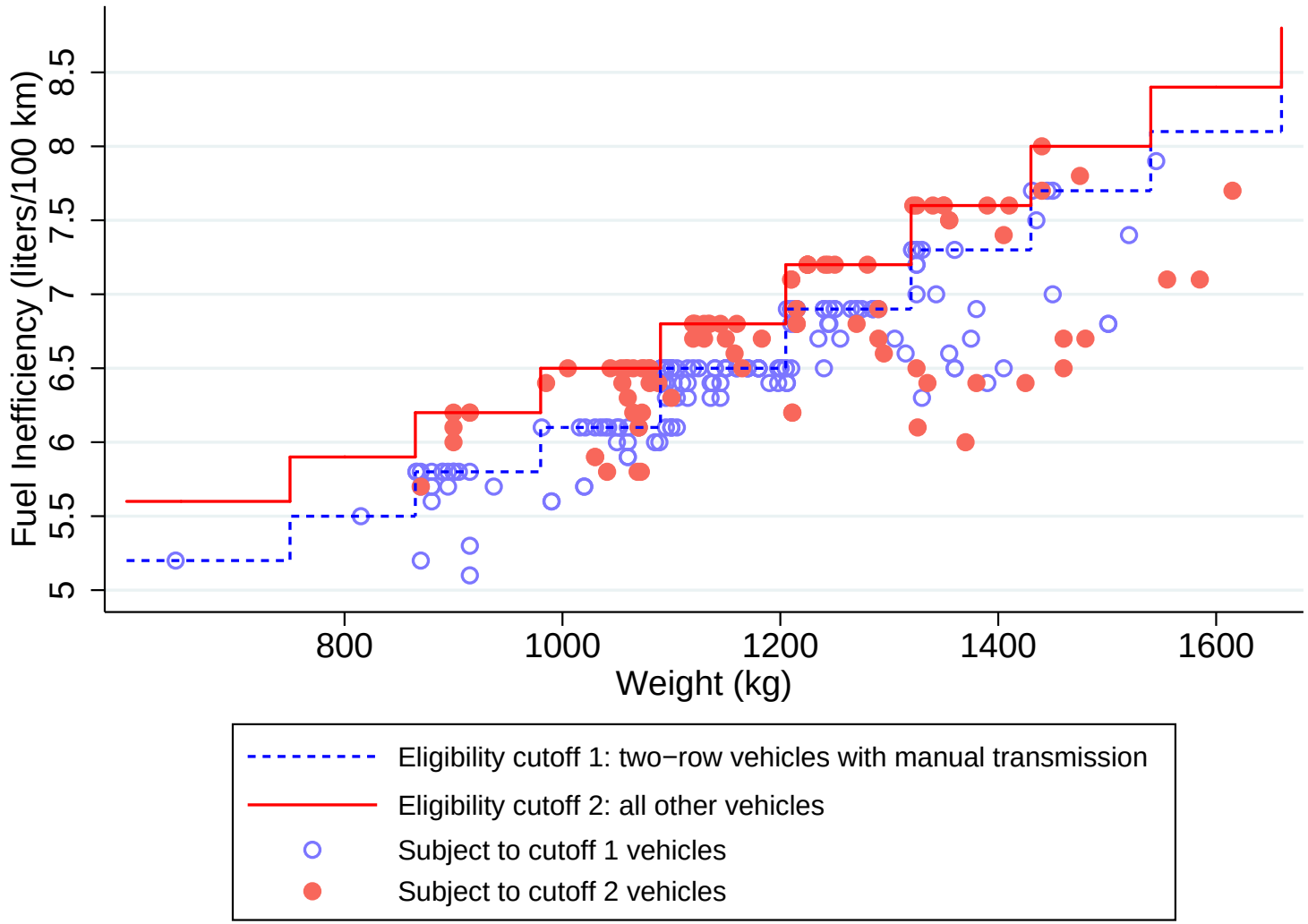
- Manufacturers must submit applications for their vehicles to be considered for a subsidy
- The program explicitly lays out its fuel efficiency standards for different types of vehicles
- Must have an engine size less or equal to 1.6 liters to be eligible

“节能产品惠民工程”节能汽车（1.6升及以下乘用车）推广目录（第一批）								
一、安徽江淮汽车股份有限公司								
序号	通用名称	车辆型号	排量（mL）	额定载客人数	变速器		整车整备质量（kg）	综合燃料消耗量（L/100 km）
					型式	挡位数		
1	同悦RS	HFC7130L1F	1332	5	MT	5	1060	6.1
2		HFC7130LTF	1299	5	AMT	5	1060	6.3
3		HFC7130LF	1299	5	MT	5	1100	6.1
4	同悦	HFC7130AF	1299	5	MT	5	1100	6.1
5		HFC7130A1F	1332	5	MT	5	1100	6.1
6		HFC7130ATF	1299	5	AMT	5	1100	6.3
7	悦悦	HFC7100W	999	5	MT	5	915	5.3
8		HFC7110WT	1075	5	AMT	5	915	5.7

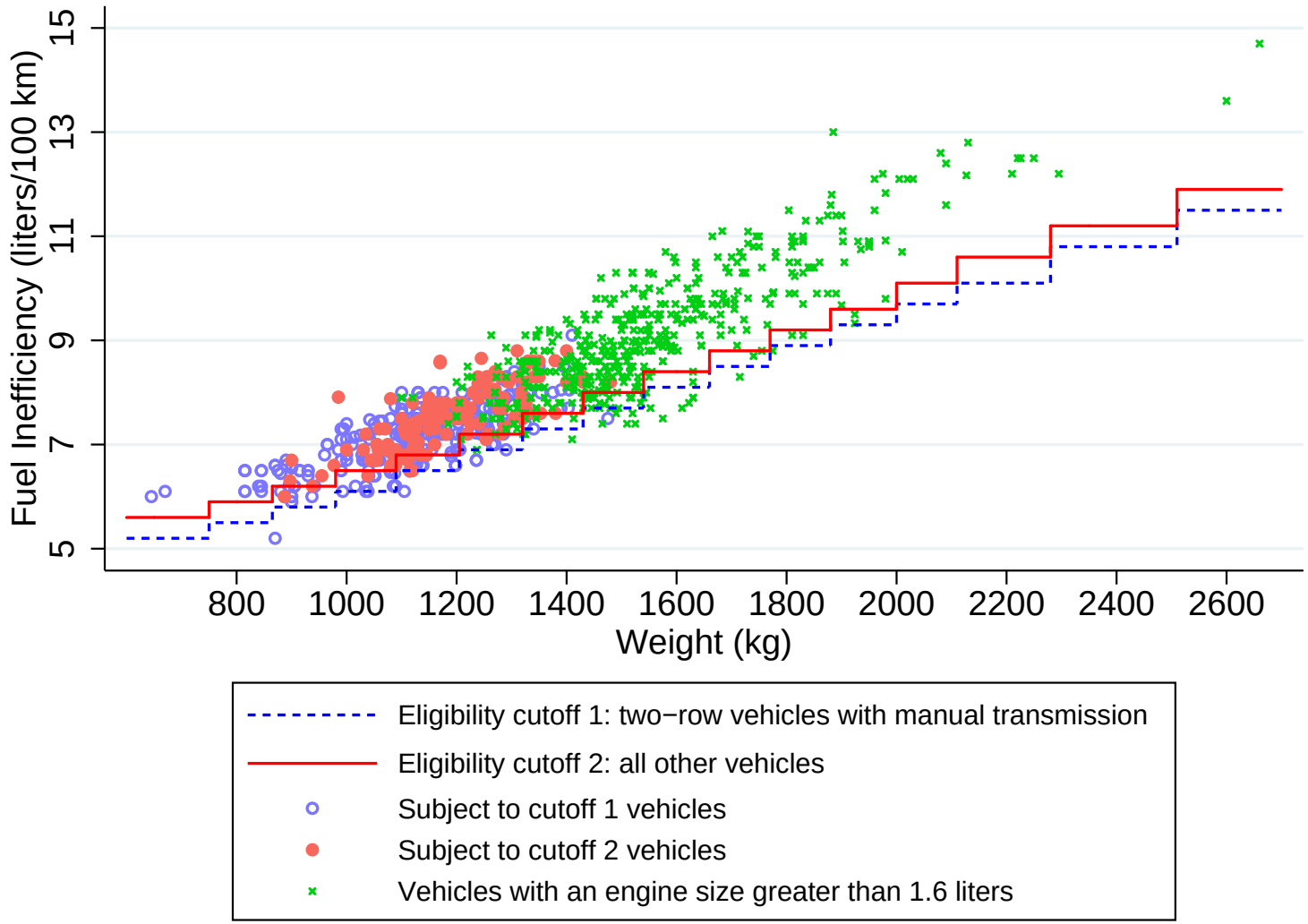
Cutoffs for Different Types of Vehicles



Fuel Inefficiency and Curb Weights: Subsidized Vehicles



Fuel Inefficiency and Curb Weights: Unsubsidized Vehicles



Data

- Sales: all new passenger-vehicle sales at the monthly level for each county from 2007-2015
- Individual characteristics
  - location of residence: county level
  - gender and age
- Vehicle characteristics
  - vehicle model id, engine size, country of origin, type of transmission (directly from the data set)
  - fuel-inefficiency and weight (from the Ministry of Industry and Information Technology)
  - transaction prices are not available
- Program eligibility: from the Ministry of Industry and Information Technology
- Currently, the preliminary results are based on two months of data (May 2010 and July 2010)

Fuel Inefficiency, Demographics and Vehicle Attributes

$$y_{ijt} = \alpha + \beta 1(\text{male})_i + \sum_{k=1}^{7} \beta_k 1(\text{age group} = k)_i + \sum_{l=1}^{7} \beta_l 1(\text{male})_i \times 1(\text{age group} = l)_i \quad (1)$$
$$+ \gamma\ 1(\text{manual transmission})_j + \sum_{r=1}^{5} \gamma_r 1(\text{engine size group} = r)_j + \sum_{s=1}^{15} \gamma_s 1(\text{weight group} = s)_j$$
$$+ \sum_{u=1}^{4} \gamma_u 1(\text{brand country group} = u)_j + \sum_{j=1}^{30} \delta_j 1(\text{province} = j) + \epsilon_{ijt},$$

- y_{ijt}: fuel inefficiency of vehicle j purchased by consumer i in month t
- Consumer level: $1(\text{male})_i$, $1(\text{age group} = k)_i$, and $1(\text{province} = j)_i$
- Vehicle level : $1(\text{manual transmission})_j$, $1(\text{engine size group} = r)_j$, $1(\text{weight group} = s)_j$, $1(\text{brand country group} = u)_j$

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- Predict counterfactual fuel inefficiency without the subsidy program, $\hat{y}_{ijt}$

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$$\text{Savings in fuel inefficiency}_{ijt} = \hat{y}_{ijt} - y_{ijt}.$$

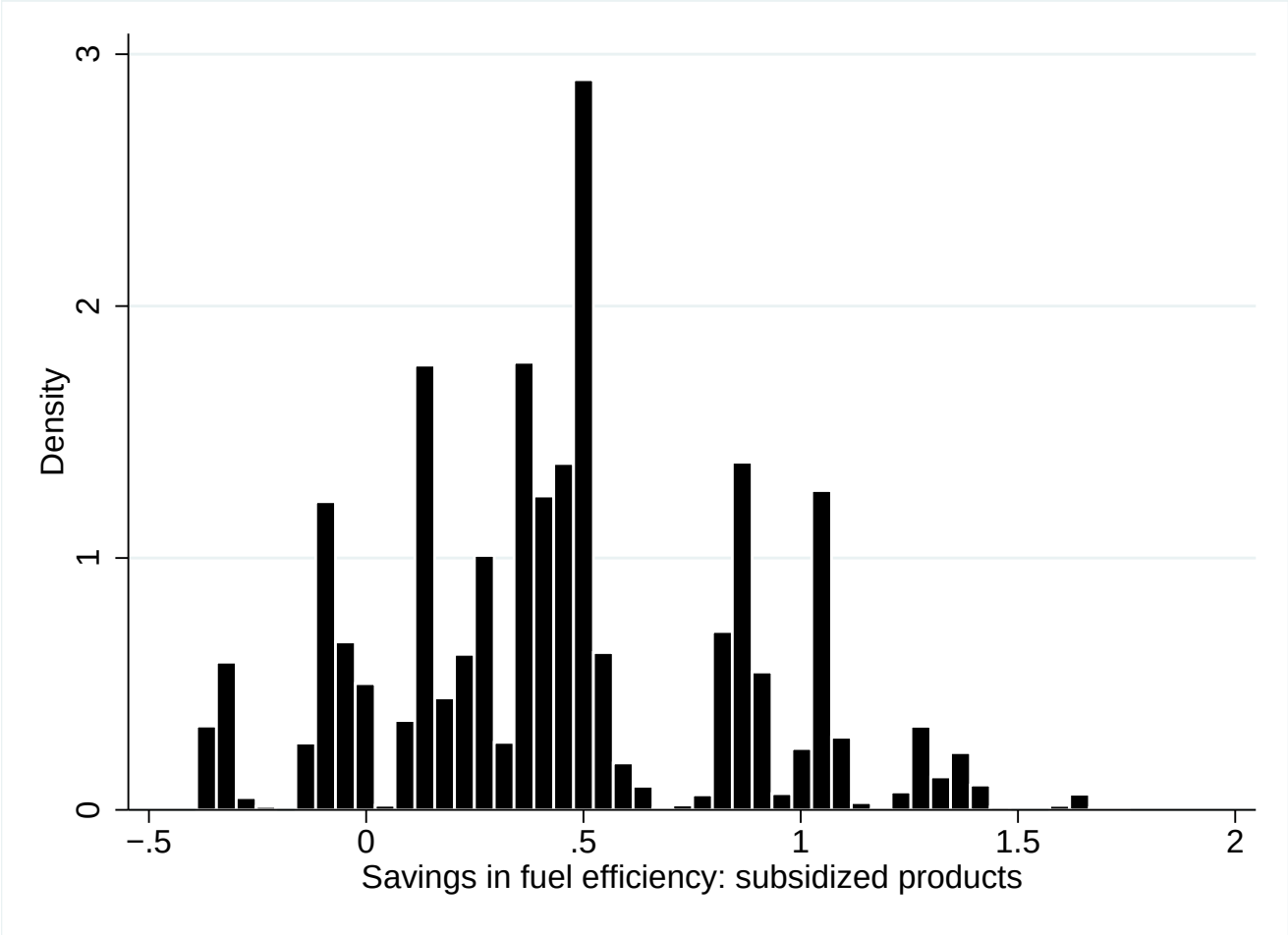
Outline

- Introduction
- The Cash Subsidy Program
- Empirical Strategy and Data
- Results

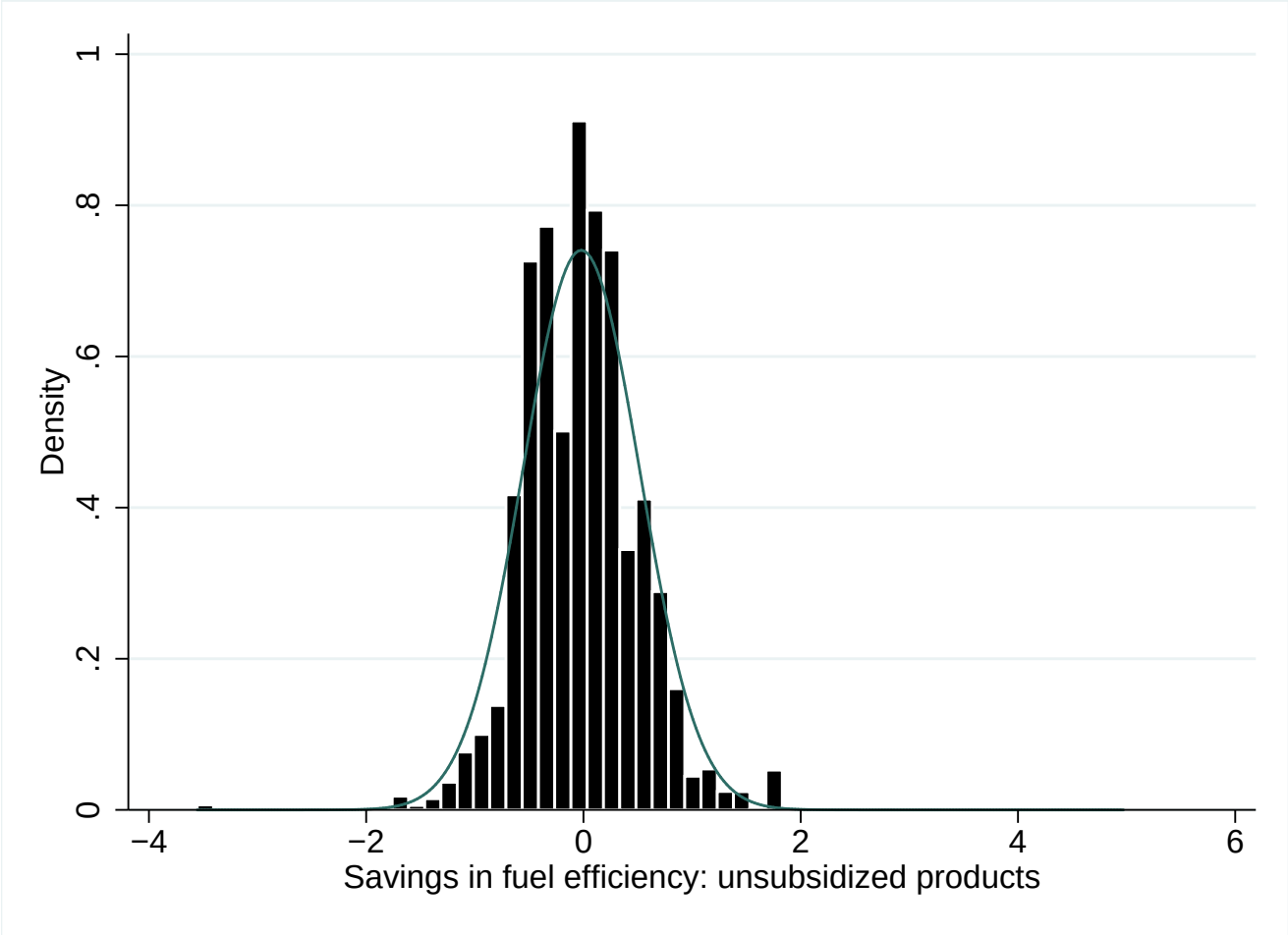
Model Estimates

Gender and Age							
male	20<age<30	30<age<40	40<age<50	50<age<60	60<age<70	70<age<80	80<age<90
0.061	0.055	0.051	0.055	0.050	0.051	-0.014	0.184
(0.100)	(0.077)	(0.078)	(0.078)	(0.078)	(0.082)	(0.088)	(0.165)
	male and 20<age<30	male and 30<age<40	male and 40<age<50	male and 50<age<60	male and 60<age<70	male and 70<age<80	male and 80<age<90
	-0.061	-0.062	-0.062	-0.056	-0.005	-0.026	-0.210
	(0.100)	(0.101)	(0.101)	(0.101)	(0.102)	(0.106)	(0.202)
Vehicle Attribute							
manual transmission	10<disp<16	16<disp<20	20<disp<25	25<disp<30	disp>30		
-0.433**	0.550**	1.041**	1.548**	1.824**	2.511**		
(0.013)	(0.035)	(0.048)	(0.052)	(0.047)	(0.140)		
European	US	Chinese	Korean				
0.045*	0.133**	0.239**	-0.054**				
(0.017)	(0.023)	(0.011)	(0.016)				
Location of Residence							
Yunnan	Inner Mongolia	Beijing	Jilin	Sichuan	Tianjin	Ningxia	Anhui
-0.043**	-0.010*	-0.075**	-0.076**	-0.028**	-0.031**	0.028**	-0.035**
(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
Hebei	Henan	Zhejiang	Hainan	Hubei	Hunan	Gansu	Fujian
-0.042**	-0.041**	-0.052**	-0.094**	-0.009**	-0.055**	0.037**	-0.061**
(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)	(0.003)
Shandong	Shanxi	Guangdong	Guangxi	Xinjiang	Jiangsu	Jiangxi	Tibet
-0.023**	-0.012*	-0.068**	-0.047**	0.065**	-0.029**	-0.050**	0.076**
(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.007)
Guizhou	Liaoning	Chongqing	Shaanxi	Qinghai	Heilongjiang		
-0.040**	-0.054**	-0.018**	-0.002	0.022**	-0.070**		
(0.005)	(0.004)	(0.003)	(0.004)	(0.005)	(0.004)		

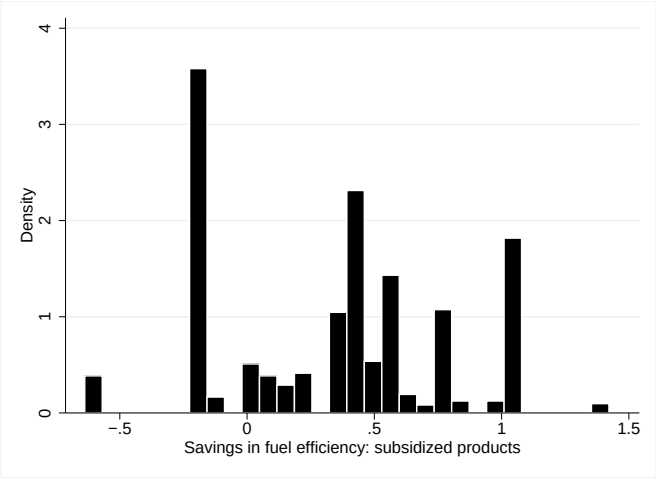
National Level: Subsidized Products



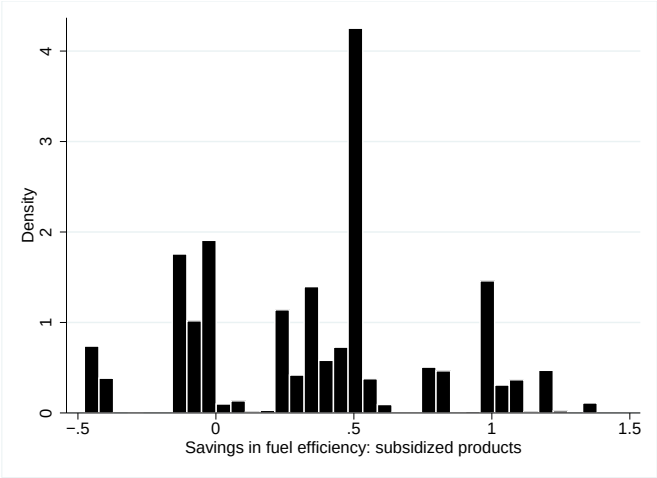
National Level: Unsubsidized Products



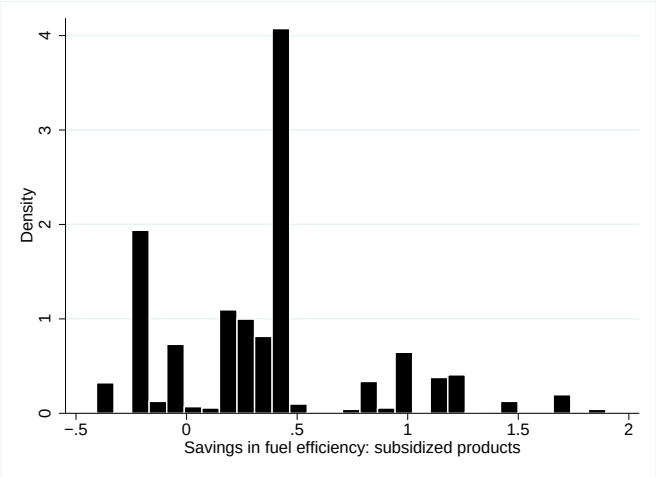
Provinces with Lowest Savings (Subsidized Products)



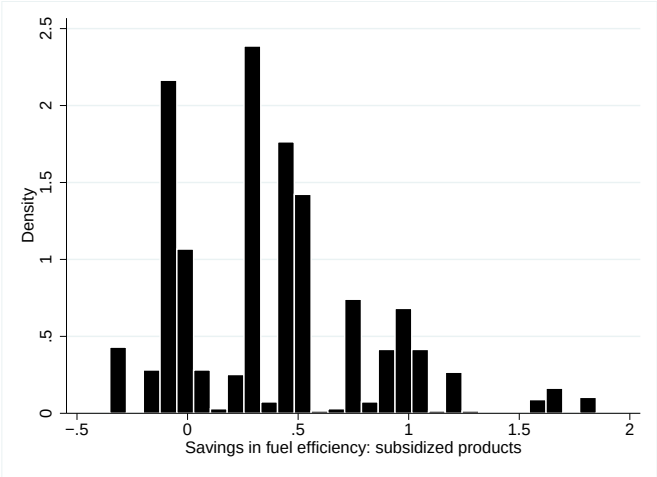
(a) Shanghai



(b) Beijing

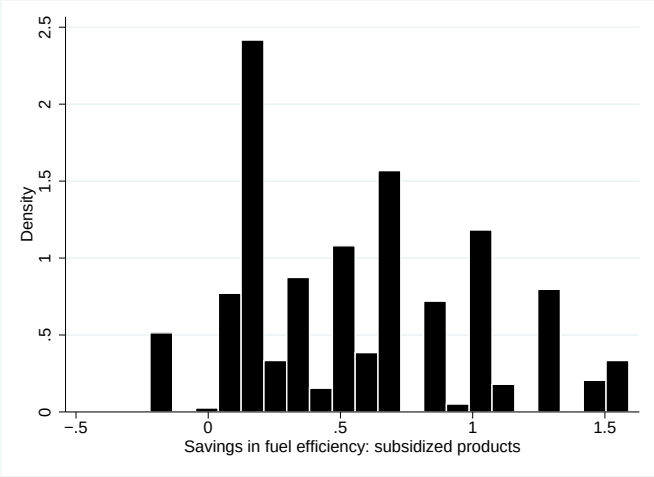


(c) Guizhou

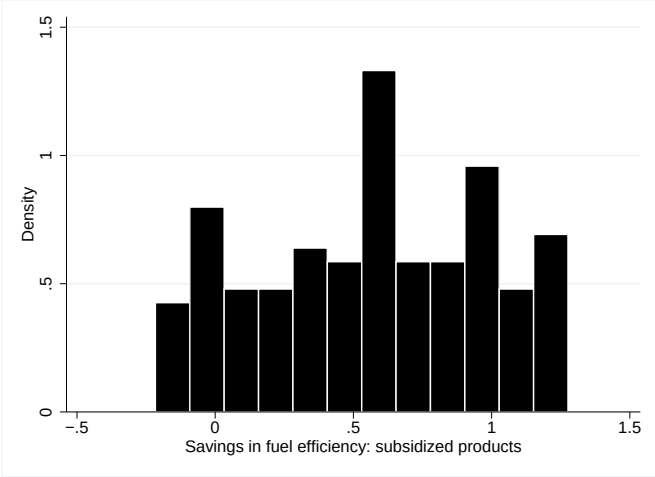


(d) Chongqing

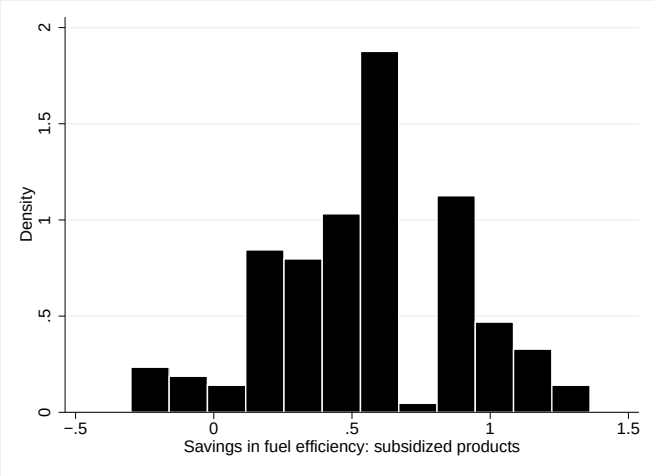
Provinces with Highest Savings (Subsidized Products)



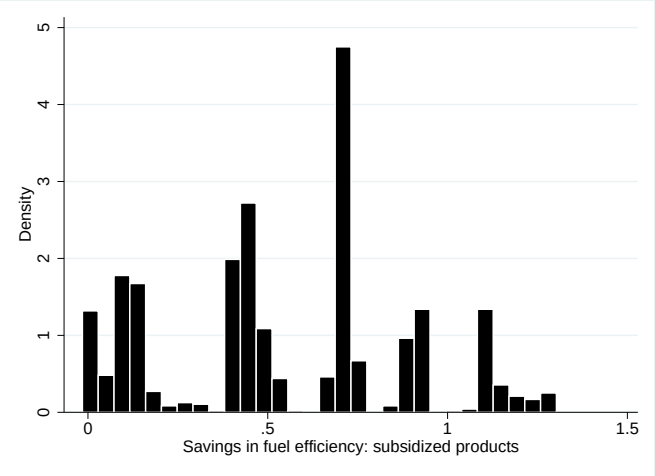
(a) Gansu



(b) Qinghai



(c) Ningxia



(d) Jilin

Conclusion

1. We find variation in fuel inefficiency associated with geographic differences
2. We find that in some places, some groups of consumers would be more likely to be nudged and switched their vehicle choices all the way across the product space to buy subsidized products

Thank you!