Appendices

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Local Protectionism, Market Structure, and Social Welfare: China's Automobile Market

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A Case Study of FAW Subsidy from July 2012 to June 2013

Between July 1, 2012 and June 30, 2013, the city government of Changchun, Jilin provided rebates to local residents who purchased one of three models by FAW, a firm based in Jilin province. According to the official document, rebate was 3,500 yuan for FAW Oley, 5000 for Besturn B50, and 7000 for Besturn B70, or about 5% of the MSRP of each model. News articles claim that the maximum rebate was up to 30,000 for the latest vintage of Besturn B70.

To evaluate the impact of this policy, we acquire additional data for year 2012 and 2013 at the city-by-month level. Figure A.1 shows the evolution of total market shares for these three models between 2009 and 2013 for the city of Chuangchun, other cities in Jilin province, and other provinces separately, with the policy window marked by the two red lines. The figure shows a substantial home bias in Jilin province, with a slightly larger home bias in Changchun than in other cities in Jilin. Before the policy window, market share of the three models in Changchun closely tracks the market share in other cities in Jilin, both following an overall downward trend. July 2012 witnessed a huge spike in market share in Changchun relative to other cities, which was followed (after a brief reversion from the peak) by an upward trend in Changchun and a downward trend in other cities within the policy window. The graph provides suggestive evidence that the subsidy increased sales of the three targeted models in Changchun.

To formally quantify the impact of the policy, we estimate the following equation using passenger vehicle sales between 2009 and 2013:

$$ln(sales_{jmt}) = \beta_1 Subsidized_{jmt} + \lambda_{jt} + \lambda_{mt} + \lambda_{jm} + \varepsilon_{jmt} \tag{A.1}$$

where the dependent variable is log-sales of model j at city m in month t. Dummy $Subsidized_{jmt}$ takes value one if j is one of the three protected FAW models, m is Changchun, and t is between July 2012 and June 2013, and $\lambda_{jt}, \lambda_{mt}, \lambda_{jm}$ are model-month, city-month, and model-city fixed

Figure A.1: Market Shares for FAW Models
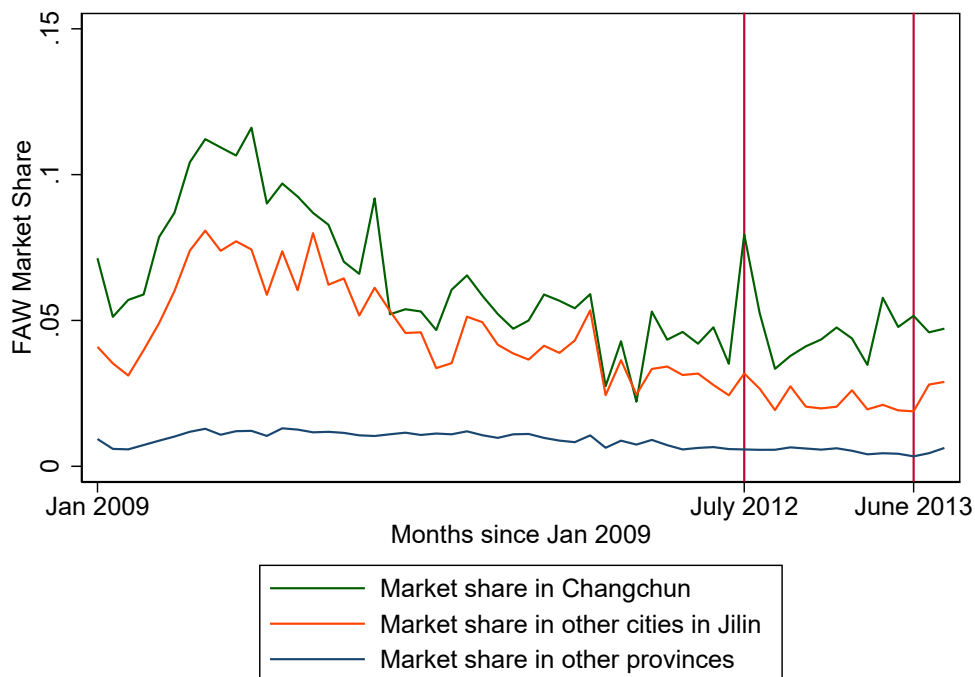
Note: This figure shows the evolution of total market shares for FAW Oley, Besturn B50, and Besturn B70 between 2009 and 2013 for the city of Chuangchun, other cities in Jilin province, and other provinces separately, with the policy window marked by the two red lines.

effects, respectively. $\hat{\beta}_1$ is a "triple difference" (DDD) estimate of the effect of the subsidy, with both within-car-model and within-city time trends differenced out in the DDD. The identification assumption for the consistency of the estimate is there there was no shock in the policy window that differentially affects sales of FAW cars in Changchun.

Table A.1: Effects of Subsidies for FAW Brands in Changchun City

	(1)	(2)	(3)
FAW brands in policy window in Changchun	0.43***	0.54***	0.54***
	(0.02)	(0.09)	(0.09)
FAW-VW brands in policy window in Changchun			-0.03
			(0.04)
Constant	1.73***	1.53***	1.53***
	(0.00)	(0.00)	(0.00)
Observations	2888540	67704	67704
R-squared	0.86	0.87	0.87
Model-city FE	✓	✓	✓
Model-month FE	✓	✓	✓
City-month FE	✓	✓	✓

Notes: The dependent variable is log(sales). All columns are estimated using OLS. Standard errors are clustered at the city level. Column (1) is estimated using all cities in China. Columns (2) and (3) are estimated using cities in Jilin province only. p<0.1, ** p<0.05, *** p<0.01.

Columns (1) and (2) of Table A.1 estimate equation (A.1) using all cities in China and only cities in Jilin province, respectively. Columns (3) examines the placebo treatment effect on models by FAW-VW, which is also based in Jilin province but was not eligible for the subsidies. Results suggest that the policy increased sales of the FAW brands in Changchun by about 54% to 71%, and had no impact on the un-subsidized FAW-models.

B Regional Variations in Dealer Discounts

Our analysis is based on MSRPs rather than retail prices since we do not have retail price data for the period studied. Heavy discounts of local products could bias our estimates of home bias. Here we document the promotion patterns based on comprehensive data on dealer promotions in March 2016 from AutoHome.com.cn. Our dataset covers 7,458 trims under 847 vehicle models that are sold in 1,176 counties across all 31 provinces in China. We drop all electric vehicles, which only became available in China in 2014. The total number of observations (trim-store) is 1.5 million. For each trim in each retail store, we calculate its discount rate based on its in-store retail price and MSRP. Table B.1 summarizes variations in discount rates across trims and regions.

Discount rates are typically low, especially for domestic brands. The average discount rate is 5%, and 40% of trim-by-store observations have no discount. Discount rates are below 10% for 95% of trims belonging to domestic brands, while less than 5% of JV or imported brands have discounts at 20% or above.

Table B.1: Summary Statistics on Discount Rates

Firm type	No. of trims	% without discount	Mean	75th percentile	95th percentile	Max
Private	147,482	51.4%	2.4%	4.4%	9.1%	35.1%
JV	863,488	32.7%	6.9%	11.7%	18.8%	37.1%
SOE	246,589	49.3%	3.3%	5.7%	12.9%	35.1%
Imports	248,839	51.8%	4.9%	9.4%	19.0%	35.0%
All	1,510,846	40.4%	5.4%	9.9%	17.9%	63.3%

Note: This table shows summary statistics of in-store discount rate by firm ownership types, pooling observations from all dealer scores together. Discount rate is calculated using observed in-store price and MSRP of the vehicle. Electric vehicles are excluded.

We find no evidence that dealer stores give heavier discounts to local product. Table B.2 shows results from a trim-level regression of discount rates on home-market dummies. The coefficients are small in magnitude. After controlling for province and trim fixed effects, coefficients for private and SOE automakers are negative, implying that their discounts are actually smaller in local markets than in other markets. Nevertheless, all three coefficients are small in magnitude (less than 0.5 percentage points) and suggest no economically significant differences in discount rates between the local and other markets.

Table B.2: Regional Variation in Promotions

	(1)		(2)		(3)	
	Est.	S.E.	Est.	S.E.	Est.	S.E.
HQ*Private	-3.39***	0.06	-0.18***	0.05	-0.41***	0.05
HQ*SOE	-2.31***	0.05	0.04	0.04	-0.16***	0.04
HQ*JV	1.66***	0.03	0.37***	0.02	-0.03	0.02
Trim FE	N		Y		Y	
Province FE	N		N		Y	

Note: The number of observations is 1,510,846. The dependent variable is the discount rate (in percentage points). * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

C   More Details on Home Bias

C.1   Home Bias by Firm

Table C.1 tabulates home bias for all 38 firms in our sample. Columns 1 and 2 report market shares of sales at the national level and in the home market where the firm is headquartered. Home bias is defined as the ratio between home share and national share minus 1. Column 3 reports home bias for individual purchases. Column 4 shows home bias for institutional purchases. Column 5 shows home bias in the number of leader stores, except for SAIG and Hafei for which we do not have data. We observe on average no home bias for private firms, substantial home bias for most JVs (median 87%), and very large home bias for SOEs (median 236%). Home bias in institutional

purchase is usually substantially larger. Home bias in dealer counts is modest compared to that in institutional purchases.

Table C.1: Home Bias by Firm

Firm	National Share, Individual	Home Share, Individual	Home Bias, Individual	Home Bias, Institutional	Home Bias, Num. dealers
Private Firms					
BYD	4.64%	4.83%	4%	13%	19%
Geely	3.68%	2.05%	-44%	-41%	-23%
Great Wall	2.01%	3.28%	63%	149%	3%
Zotye	0.39%	0.28%	-28%	17%	-35%
Lifan	0.38%	0.98%	160%	128%	95%
Hawtai	0.12%	0.10%	-20%	-100%	-25%
JVs					
GM Shanghai	9.68%	17.54%	81%	117%	52%
VW Shanghai	8.59%	24.31%	183%	71%	
VW FAW	7.79%	21.36%	174%	177%	57%
Hyundai Beijing	6.46%	7.33%	13%	155%	7%
Nissan Dongfeng	5.61%	11.20%	100%	70%	46%
Toyota FAW	4.88%	4.25%	-13%	142%	25%
Ford Changan	3.91%	6.69%	71%	187%	77%
Honda Guangzhou	3.70%	6.97%	88%	87%	86%
PSA Dongfeng	3.32%	11.13%	235%	689%	84%
Kia Yueda	3.24%	3.26%	1%	39%	15%
Honda Dongfeng	3.70%	6.97%	93%	138%	31%
Toyota Guangzhou	2.44%	5.35%	119%	91%	61%
Suzuki Changan	1.89%	2.21%	17%	742%	-1%
Soueast	0.94%	1.38%	48%	685%	37%
GM Shanghai Wuling	0.82%	3.66%	345%	451%	206%
Suzuki Changhe	0.81%	1.35%	67%	213%	150%
BMW Brilliance	0.63%	0.56%	-11%	4%	29%
Daimler beijing	0.35%	0.64%	85%	148%	39%
Zhengzhou Nissan	0.18%	0.50%	185%	236%	49%
Changfeng	0.03%	0.07%	133%	197%	58%
SOEs					
Chery	4.63%	11.63%	151%	293%	67%
FAW	2.38%	7.20%	203%	379%	187%
Xiali	2.38%	16.22%	598%	475%	325%
Chana	1.50%	4.52%	201%	238%	193%
JAC	1.30%	5.43%	319%	306%	132%
SAIG	1.25%	3.04%	144%	149%	NA
Haima	1.16%	2.63%	127%	1228%	66%
Brilliance	0.86%	3.02%	250%	482%	234%
Dongfeng Liuzhou	0.41%	1.33%	222%	750%	70%
Daihatsu-FAW	0.31%	1.23%	303%	661%	96%
Dongfeng	0.22%	1.82%	706%	956%	321%
Hafei	0.17%	1.16%	602%	2562%	NA

Note: This table shows different measures of home bias for each of the 38 firms in our main sample. National market share and home-province market shares are calculated using total sales from 2009 to 2011. Home bias is the ratio between national share and home-province share minus 1.

C.2 Heterogeneity in Home Bias

There is a large positive correlation between home biases in individual and institutional purchases (Figure C.1). This correlation persists when we look within each ownership type, as shown in Figure C.2. In contrast, Figure C.3 to Figure C.5 indicate that there is no correlation between home bias in individual purchases and firm age, model's market share outside the home province, or vehicle prices, with the only exception that home bias is modestly higher for older JVs.

**Figure C.1:** Home Biases in Individual and Institutional Purchases
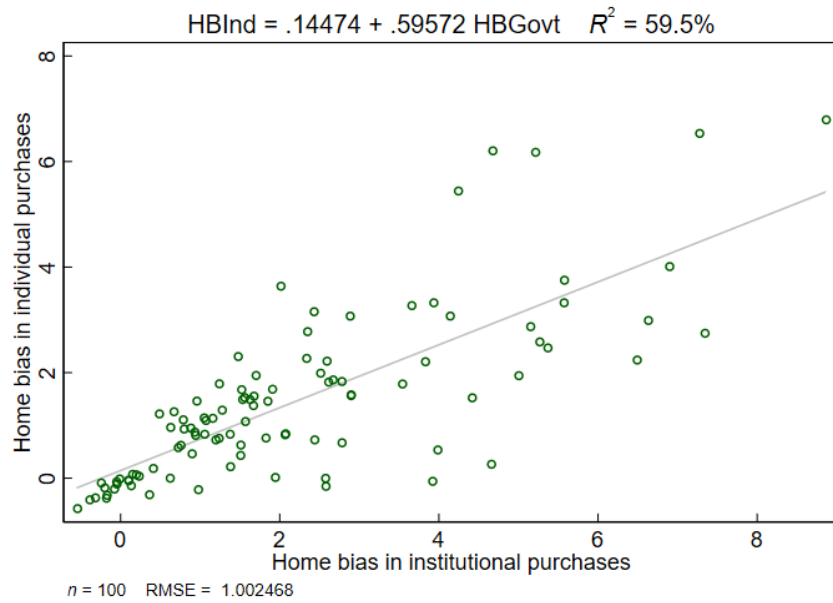
Notes: Each data point is a firm-year. We define home bias as the ratio between home market share and national share minus one. We drop 10 outliers with home bias in government purchases above 10.

**Figure C.2:** Home Biases in Individual and Institutional Purchases by Firm Types

(a) JVs   **(b)** Private firms   **(c)** SOEs

Notes: Each data point is a firm-year.

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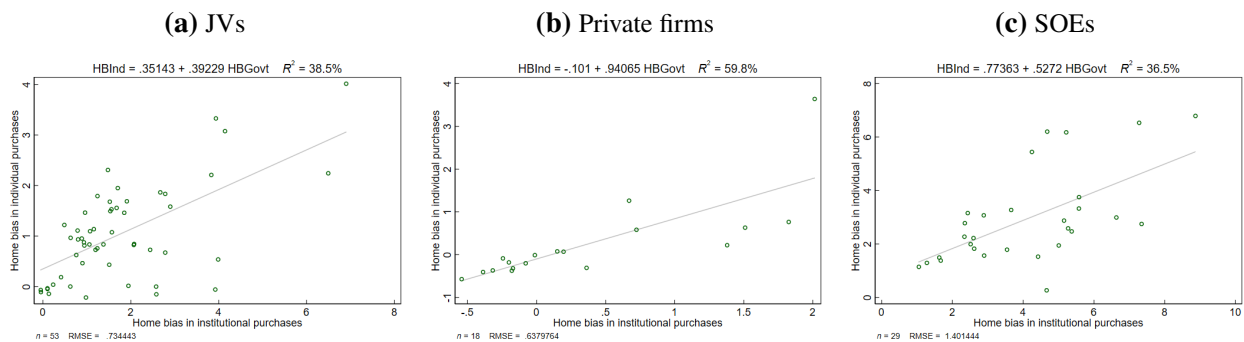
Figure C.3: Correlation between Home Bias and Firm Start Year

**(a)** JVs   **(b)** Private firms   **(c)** SOEs
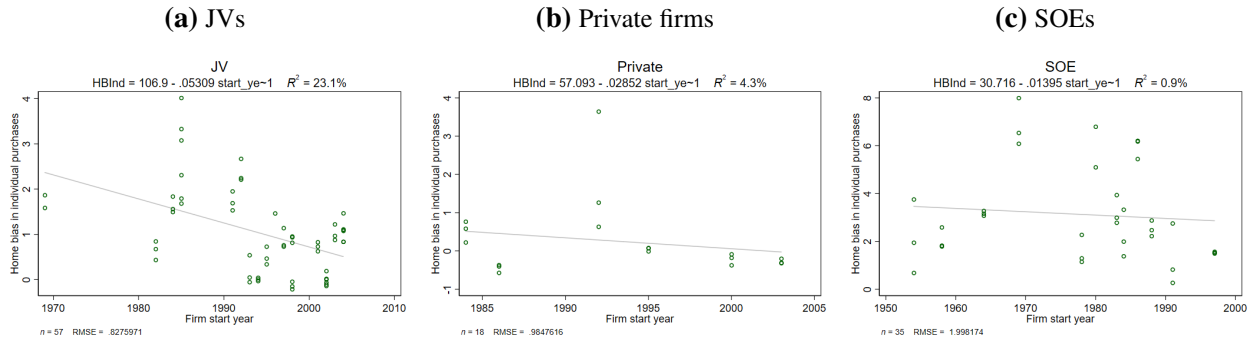
Notes: Each data point is a firm-year. Firm start year is the year in which the first was first registered.

Figure C.4: Correlation between Home Bias and Market Share outside the Home Province

(a) JVs   **(b)** Private firms   **(c)** SOEs
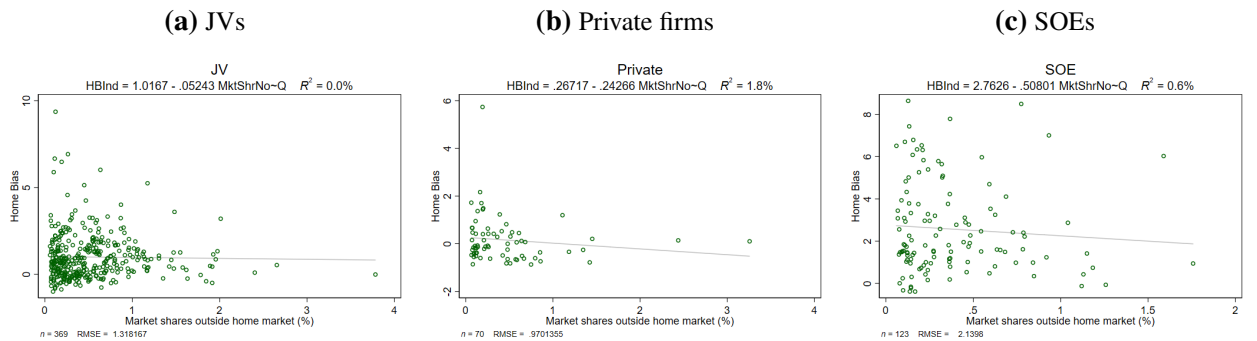
Notes: Each observation is a model-year.

Figure C.5: Correlation between Home Bias and Vehicle Price

(a) JVs   **(b)** Private firms   **(c)** SOEs
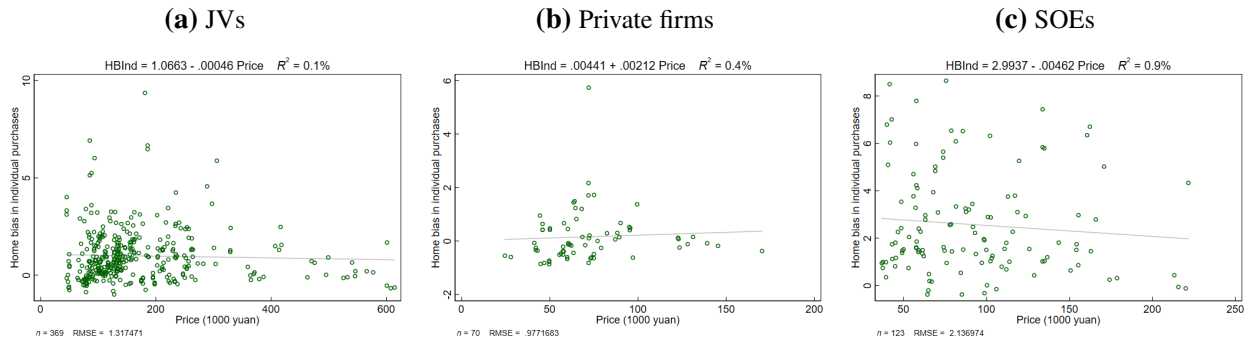
Notes: Each observation is a model-year. Price is the manufacturer suggested retail price in 1000 yuan.

D   Survey on Consumer Awareness of Local Products

This survey is designed to gauge the extent to which consumers are informed about ownership type and location of automakers, as well as the importance of buying local brands in vehicle purchase decisions. The survey questionnaire (see below) is distributed to visitors in dealership stores in Chongqing in November 2016. Each survey takes about two minutes to fill out and is collected on site.

We choose to conduct the survey in Chongqing for two reasons. First, it is home to the fourth largest private automaker, LiFan, and the fourth largest SOE, Chana. Second, since Chongqing is much smaller compared to an average province in China in terms of the land area, one would expect its residents to know the local industries better. Therefore, our results should give a conservative estimate of the lack of awareness for local firms.

Dealer Visitor Survey Questionnaire

Dear Customer,

How are you? I am a college student in Southwest University and doing a consumer survey on vehicle choice. This survey will only takes two minutes of your time. Please answer the questions below. Thanks for your support!

Gender: Male   Female

Age: <30, 30-40, 40-50, >50

Education: High school or below,   College,   Post-college

This question is about the ownership type of auto makers:

Great Wall is:	SOE	Private	Joint-venture	Import	Don't know
LiFan is:	SOE	Private	Joint-venture	Import	Don't know
ChangAn is:	SOE	Private	Joint-venture	Import	Don't know
Cheri is:	SOE	Private	Joint-venture	Import	Don't know
Geely is:	SOE	Private	Joint-venture	Import	Don't know

This question is about the location of auto makers:

BYD is:	Local	Non-local	Don't know
Chanan is:	Local	Non-local	Don't know
Chery is:	Local	Non-local	Don't know
LiFan is:	Local	Non-local	Don't know
Zotye is:	Local	Non-local	Don't know

How important are these factors in your vehicle choice decision?

Liters per 100 km is:	Not important	Somewhat	Very
Brand reputation is:	Not important	Somewhat	Very
Total price is:	Not important	Somewhat	Very
Buying a local brand is:	Not important	Somewhat	Very
Engine size is:	Not important	Somewhat	Very

Among 315 surveys deployed, 297 are complete and our analysis is based on these responses. Table D.1 presents the summary statistics of the responses by demographic groups. The last row shows the results for the full sample. In column (2), the average score of 2.14 out of 5 on ownership questions implies that about 40% of the questions are answered correctly (which is marginally better than a random guess of 33%). On locations questions, the average score of 3.16 implies that about 60% of the questions are answered correctly (a random guess would get 50% right). Out of all respondents, only one correctly answered all 10 questions. About 43% of respondents consider

buying local brands as being unimportant. In contrast, only 14% and 28% of them consider price and brand reputation as being unimportant.

Male respondents are slightly more informed than their female counterparts. They are also less concerned about local brands and vehicle prices in their purchase decisions relative to female respondents although the differences are small. Age but not education seems to help with awareness on ownership type and location of automakers. Younger buyers tends to care less about local brands but more about price and reputation.

Table D.1: Summary Statistics by Demographics

| Demographics | Percent | Mean score (out of 5) | | Factors not important | | |
		Ownership type	Local or not	Local or not	Price	Reputation
	(1)	(2)	(3)	(4)	(5)	(6)
Gender						
Female	46.5	2.11	3.07	42.0	12.3	28.3
Male	53.5	2.17	3.25	43.4	15.1	28.3
Age						
<30	32.3	2.01	2.91	51.0	14.6	26.0
30-40	34.7	2.02	3.10	35.0	15.5	28.2
40-50	24.6	2.47	3.42	42.5	9.6	27.4
>50	8.4	2.20	3.64	44.0	16.0	40.0
Education						
≤ High school	40.7	2.32	3.43	43.0	11.6	32.2
College	39.7	2.02	3.03	40.7	16.9	22.0
Post-college	19.5	2.02	2.88	46.6	12.1	32.8
All	100.0	2.14	3.16	42.8	13.8	28.3

Notes: There are five questions on ownership and five questions on local status. Column(1) shows the percentage of respondents by demographic groups. Columns (2) and (3) present the average scores on the two sets of questions. Columns (4) to (6) show the percentage of respondents who consider each factor being unimportant in their vehicle purchase decisions. The other two factors that are not shown are fuel economy and engine size. In terms of the percentage of respondents who consider them being unimportant, they are in between brand reputation and price.

E Computational Details

As pointed out by Dube et al. (2012); Knittel and Metaxoglou (2014) and a few others, computational issues are important in nonlinear estimations like BLP. We provide the analytic gradient for both the macro- and micro- moments, set the convergence criterion for the contraction mapping to $1e^{-14}$, and use a large number of Halton simulation draws (1000 draws) to improve the accuracy of numeric integration. For each estimation run, we use 20 to 50 starting values and only keep parameter estimates that produce the lowest GMM objective function value and satisfy the first order condition (the maximum absolute value for the gradient vector of the objective function is smaller than $1e^{-7}$).
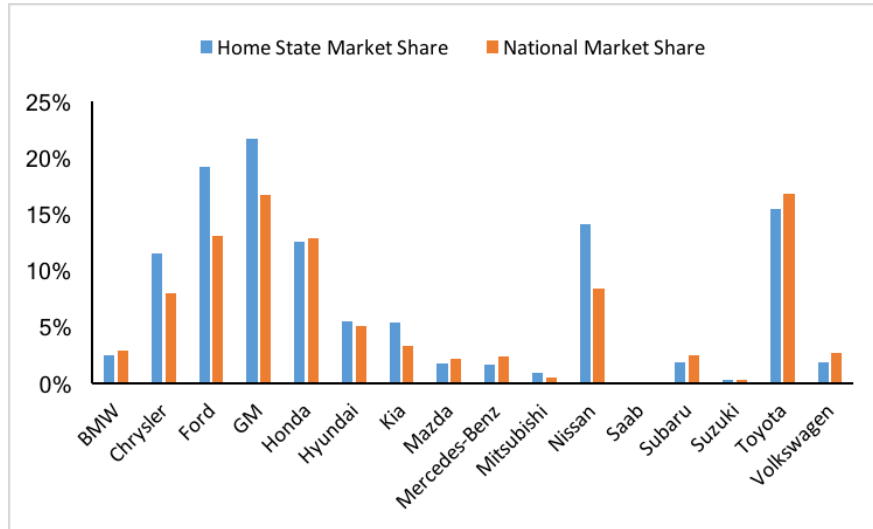
F Additional Figures and Tables

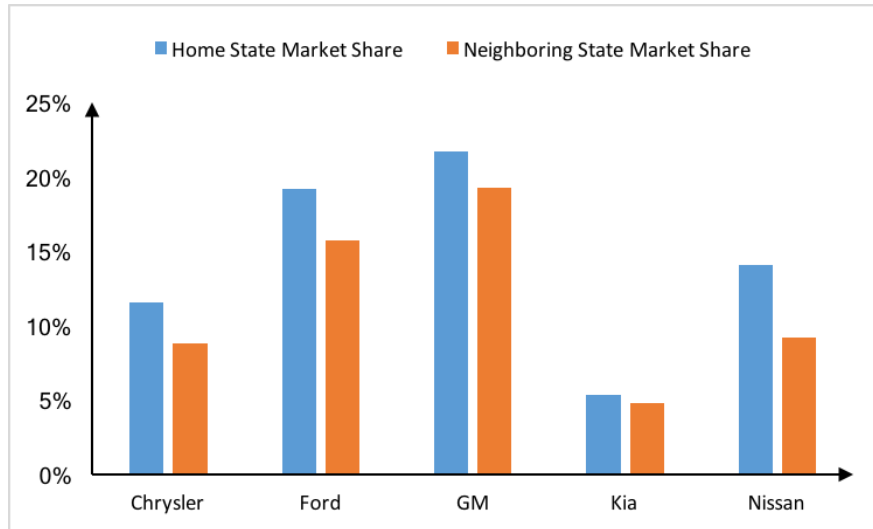**Figure F.1:** New Passenger Vehicle Sales in China and U.S.
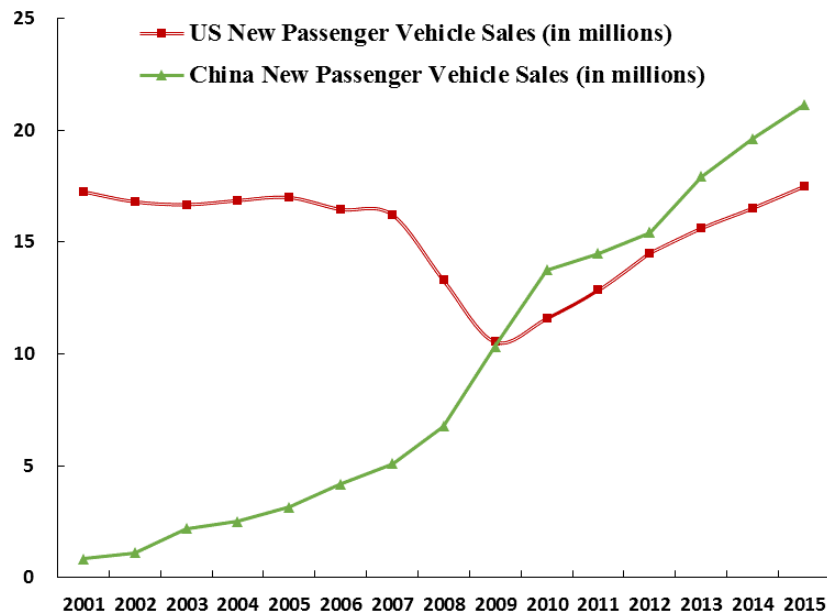
Source: Marklines Automotive Industry Portal vehicle sales data.

Figure F.2: Home-state and National Market Shares

(a) Home Bias Compared to All Other States

(b) Home Bias Compared to Adjacent States

Notes: Market shares are calculated using sales volume between 2009 and 2011. "Home State" are defined as the set of states where the firm has assembly plants. Adjacent states in panel (b) are defined as all states that share borders with the home states.

Figure F.3: Model-level Price Elasticities
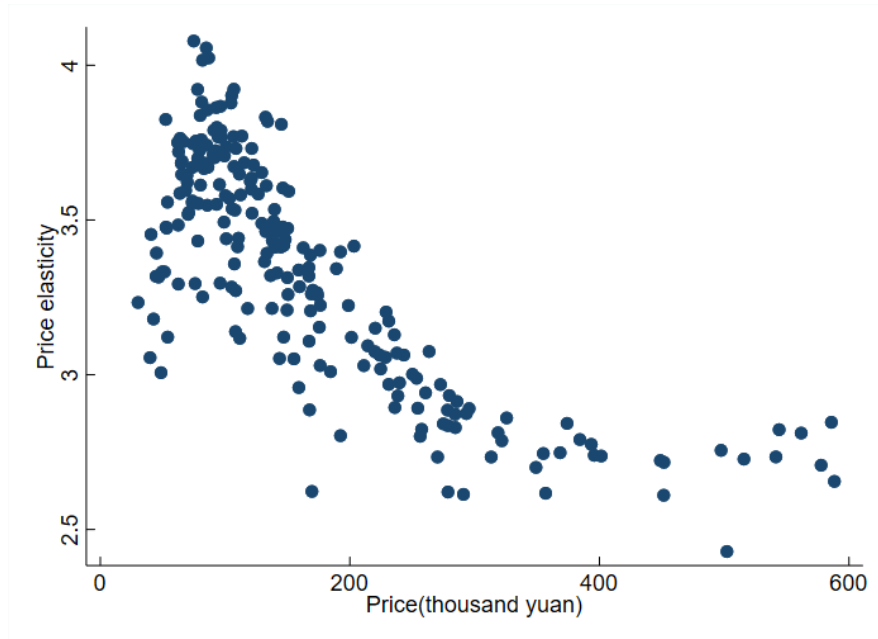
Notes: Each data point represents a model-year (631 data points in total). Price elasticity is the percentage change (in absolute values) in a model's national sales in a year due to a one-percentage change in MSRP.

Table F.1: Micro-moments: Fraction of Vehicle Buyers by Annual Income

(a) Fraction of Households by Annual Income (yuan)

Year	< 48k	48k − 96k	96k − 144k	≥ 144k
Among Vehicle Buyers				
2009	0.16	0.34	0.32	0.19
2010	0.11	0.27	0.32	0.30
2011	0.09	0.26	0.34	0.31
Among All Households				
2009	0.69	0.23	0.05	0.03
2010	0.63	0.27	0.06	0.04
2011	0.55	0.33	0.08	0.04

(b) Fraction of Buyers by Income Brackets for Different Vehicle Segments, 2011

Segment	< 48k	48k − 96k	96k − 144k	≥ 144k
Small/mini sedan	0.15	0.40	0.30	0.15
Compact sedan	0.11	0.30	0.37	0.22
Medium/large sedan	0.05	0.16	0.32	0.47
SUV	0.05	0.15	0.33	0.47
MPV	0.07	0.24	0.33	0.36

Note: The micromoments are based on an annual nationally representative household survey of new vehicle buyers from Ford Motor Company.

	(1)		(2)		(3)		(4)	
	Est.	S.E.	Est.	S.E	Est.	S.E	Est.	S.E
Linear parameters								
log(Fuel cost)	-1.41***	0.22	-1.40***	0.21	-1.27***	0.21	-1.36***	0.21
log(Displacement)	3.38***	0.16	3.36***	0.16	3.22***	0.15	3.29***	0.16
log(Size)	6.71***	0.22	6.73***	0.22	6.42***	0.21	6.63***	0.22
Auto Transmission	0.65***	0.03	0.65***	0.03	0.62***	0.03	0.64***	0.03
Distance to headquarter			-0.07***	0.02	-0.06***	0.02	-0.06***	0.02
Number of dealers					0.01***	0.00	0.01***	0.00
Price coefficients								
$e^{\bar{\alpha}_1}$	28.65***	2.93	28.58***	2.93	24.41***	2.44	28.23***	2.90
$e^{\bar{\alpha}_2}$	17.41***	1.32	17.41***	1.32	15.23***	1.12	17.15***	1.31
$e^{\bar{\alpha}_3}$	6.42***	0.40	6.43***	0.40	5.80***	0.35	6.31***	0.40
$e^{\bar{\alpha}_4}$	5.50***	0.43	5.54***	0.43	5.03***	0.39	5.43***	0.42
Discount parameters								
Private discount ρ_1	0.04	0.04	0.03	0.05	0.04	0.05	0.04	0.04
JV discount, ρ_2	0.22***	0.02	0.21***	0.02				
SOE discount, ρ_3	0.34***	0.03	0.33***	0.03				
JV discount 2009, ρ_{20}					0.17***	0.03		
JV discount trend, γ_2					0.01	0.02		
SOE discount 2009, ρ_{30}					0.32***	0.05		
SOE discount trend, γ_3					0.02	0.03		
JV discount tier 1, ρ_{21}							0.16***	0.03
JV discount tier 2, ρ_{22}							0.22***	0.04
SOE discount tier 1, ρ_{31}							0.29***	0.03
SOE discount tier 2, ρ_{32}							0.37***	0.05
Dispersion parameters								
Constant, σ_1	3.38***	0.20	3.38***	0.20	3.22***	0.19	3.32***	0.19
log(Fuel cost), σ_2	0.96***	0.05	0.97***	0.05	0.89***	0.05	0.95***	0.05
price, σ_p	1.26***	0.04	1.26***	0.04	1.22***	0.04	1.26***	0.04

Note: The number of observations is 19,505. Column (1) replicates our main results, but exclude both distance to headquarter and the number of dealers as controls. Column (2) excludes the number of dealers as a control. Column (3) allows the discount rate for JVs and SOEs to change linearly oer time. Column (4) divides provinces with local JVs and SOEs into two tiers above and below the median home biases in institutional purchases, and estimate tier-specific discount rates.

References

Dube, Jean-Pierre, Jeremy T. Fox, and Che-Lin Su, "Improving the Numerical Performance of Static and Dynamic Aggregate Discrete Choice Random Coefficients Demand Estimation," *Econometrica*, 2012, *80* (5).

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(1).