Heterogeneous Impacts of Vertical Restraints Antitrust Event? Evidence from China's Auto Market

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[*Working Paper*]

April, 2022

Abstract

I examine the impacts of vertical restraints antitrust practices on consumer and producer behaviors in the auto market exploiting China's first antitrust case in the auto market (the 2014 Audi case) as an exogenous shock and investigate the persistence of the event impacts. Using a combination of difference-in-differences and demand estimation methods, I find that the 2014 antitrust event led to the prices set by both Audi automakers and dealers decreasing by 4% and an unexpected consumers' utility evaluation of Audi increasing by 84%. Leveraging novel transaction-level data, I study the differences between transaction prices set by dealers and manufacturers' suggested retail prices (MSRP) set by manufacturers to check whether the event led to significant changes in the vertical relationship. The results show that the transaction price and MSRP ratio did not decrease significantly after the event implying that dealers did not gain more pricing power after the antitrust event. I conclude that the antitrust case on automakers' price control actions is likely to be a one-shot market shock in the context of China's auto market.

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1 Introduction

Vertical restraints (or vertical control) refer to competition restrictions embedded in contracts and agreements between firms or individuals at different levels of the production and distribution process. They include price restrictions, such as resale price maintenance (e.g., price floors, ceilings, or controls) and two-part tariffs; product restrictions, such as tying agreements or bundled products; customer restrictions; and territorial restraints imposed by upstream firms on downstream firms (Qiao, 2017).

As a focus of legal regulation, the impacts of vertical restraints have been actively debated by theoretical economists (Grossman and Hart, 1986; Hart and Tirole, 1990; Rey and Verge, 2005) over the last few decades. A school of thought in economics(Tirole, 1988) posits that vertical restraints can mitigate negative externalities (e.g. double marginalization), lead to positive impacts on market competitions, and enhance overall welfare in the presence of information asymmetry. However, there are also literature arguing that, where vertical restraints may cause abuse of market power or market foreclosures, and thus hinder competition, and ultimately harm the consumers(Horn and Wolinsky, 1988).

Although there is a substantial body of theoretical literature on vertical restraints, very few studies have documented the empirical impacts of antitrust enforcement on these practices. The closely related literature primarily focuses on the welfare impacts of vertical integration (Crawford, Lee, Whinston and Yurukoglu, 2018; Luco and Marshall, 2020). Current research remains largely silent on the analysis of vertical restraints and related antitrust actions due to a lack of data. Moreover, there is little direct economic evidence showing how antitrust actions on vertical control practices (such as monopolization, collusion, and mergers) affect competition and consumers. The uncertainty surrounding consumers' and firms' behaviors in response to vertical restraints antitrust actions makes it even more challenging to quantify the potential consequences of such enforcement. This gap leaves a significant disconnect between economic theory and the appropriate legal treatment of vertical restraints. As Crandall and Winston (2003) states, "although economic theory can help organize the analysis of the economic variables affected by antitrust policy, it often offers little policy guidance because

almost any action by a firm short of outright price-fixing can turn out to have pro-competitive or anticompetitive consequences."

The legal enforcement of vertical restraints has long been one of the most controversial topics in antitrust law and regulations (Posner, 2005; O'Brien, 2008). Consequently, context-specific antitrust actions are often taken to curb vertical control and promote market competition around the world[1]. In China, the situation has been similar. However, on August 6, 2014, national agencies announced the first national antitrust case in the automobile industry, addressing the price-fixing of the Audi brand under FAW-Volkswagen (FAW-VW) over dealers in Hubei Province.

This paper exploits China's external antitrust enforcement shock in the automobile market in August 2014 and studies the impacts of vertical restraints antitrust events on consumers and automakers behaviors. My research questions are: 1) What are the short-term impacts of the price restraint antitrust events on the quantity sales and prices of the convicted brands? 2) How do consumers, automakers, and dealers respond to the price restraint antitrust event? 3) Are the impacts of the antitrust event persistent or one-time?

To answer these questions, I first study the impacts of the 2014 Audi antitrust case on the sales and prices of the convicted brand (Audi) using a combination of difference-in-differences and demand estimation methods. The main identification strategy relies on the parallel trend assumption before the event. My analysis shows that the vertical restraints antitrust event had sizable effects, with utility evaluation for Audi increasing by 84% and prices decreasing by 6% overall after the antitrust enforcement, relative to the control group. Besides, I examine the tracking pattern between transaction prices and MSRPs using a novel transaction data set and find no evidence that the event stopped vertical control over the dealers. The results contradict the belief that the vertical restraints antitrust events would deter automakers from vertical price controls over dealers or lead to more price competition. Under the caveat that market structure remains unchanged, our analysis reveals the possibility of a one-shot antitrust event.

Besides the evaluation of China's antitrust actions in the automobile market, my work is a novel empirical study comparing the demand estimation using both manufacturers' suggested

[1]However, in the US, retail price maintenance (RPM) is currently illegal per se.

retail price (MSRP) with transaction prices. MSRP has been widely used in the demand estimation of the auto market due to its convenience or lack of data(Li, 2018). In my paper, I document the tracking patterns between both MSRP and transaction prices in the auto market. Though manufacturers' suggested retail prices and transaction prices are set by different agents in the market, the results of this paper provide empirical evidence supporting the usage of the manufacturer's suggested retail price in place for transaction prices in the demand estimation of the auto market.

Regarding the legal practice, this paper complements current empirical works though studies have argued that it is unwise to adopt a formal approach for the legal assessment of the vertical restraints (Buccirossi, 2015), economic literature has been silent on developing an empirical approach to quantify the welfare impacts. Verouden (2008) studies the motivation and impacts of vertical agreements and claims a general method of per se prohibitions on price restraints is reasonable despite the that it's unlikely to be appropriate. Though previous work has provided some quantitative assessment of vertical relationships, little focus on how the strategic responses of manufacturers to vertical restraint enforcement affect the market outcomes. In the context of vertical restraints consequences and regulations, this study takes advantage of the temporal variation of an exogenous policy shock and empirically examines the heterogeneous impacts of vertical restraints antitrust events.

My analysis relates to studies on the vertical relationships. Theoretically, the trade-off of vertical restraints comes from potential efficiencies gained from the elimination of double marginalization (Spengler, 1950 and alignment of investment incentives (Grossman and Hart, 1986; Murry, 2017) with the potential losses led by incentives to foreclose rivals and raise their costs (Hart and Tirole, 1990). Despite the growing antitrust cases and qualitative analyses of vertical mergers (Evans, 2013; Crawford, Lee, Whinston and Yurukoglu, 2018; Luco and Marshall, 2020), there are very few empirical studies quantifying the impacts of vertical restraints due to the unobservable features of vertical contracts. This paper provides novel empirical evidence on the impacts of a vertical restraint antitrust event on consumers and producers in the auto industry.

My work also adds to the emerging literature on China's antitrust regulations and policies in

the automobile market. China has been the world's largest automotive manufacturing country and market since 2009, accounting for nearly 30% of worldwide vehicle production in 2021[1]. Among all manufacturers, over 80% are joint ventures. China's domestic antitrust policies related to the automobile market and joint ventures, such as Audi, could have significant global impacts, yet our understanding of these policies' effects is very limited. Qiao (2017) reviewed the legal treatment of vertical restraints and examined the possible influence of the 1977 landmark case of Sylvania on China's antitrust enforcement of vertical restraints. My paper provides a novel perspective on China's antitrust actions in the automobile market.

The remainder of the paper is organized as follows. Section 2 describes the background of China's price restraint antitrust events and provides data on China's auto market. Section 3 presents empirical evidence using a difference-in-differences analysis and interprets the results through the lens of demand and supply. Section 4 investigates the persistence of the event's impacts. Section 5 discusses our findings. Section 6 concludes.

2 Background and Data

2.1 Background

2.1.1 China's Actions Against Vertical Restraints

Since market reform and open-up policy in 1978, China has made great strides in transforming its centrally-planned economy into a market-oriented economy. To initiate a formal competition environment, China announced the first comprehensive antitrust law - the Anti-monopoly Law ("AML") in 2008.

In terms of vertical restraints, Article 14 of AML specifically prohibits certain vertical restraints, including resale price maintenance, either by fixing the resale price or by imposing a minimum resale price for resale to a third party. Meanwhile, Article 15 of the AML lists several conditions under which vertical restraints can be exempted from Article 14's prohibitions such as improving technologies, upgrading product quality, enhancing operational efficiency,

[1]Source: https://www.statista.com/topics/1050/automobile-manufacturing-in-china/

mitigating serious decrease in sales volume, etc. Besides, the AML does not expressly prohibit any other types of vertical restraints such as exclusive deals or tying agreements.

Since the publication of the Anti-monopoly Law, there have been hundreds of antitrust cases in many industries such as pharmaceutical companies and milk powder suppliers. The automobile industry had not been under the radar of China's antitrust enforcement for several years until 2014. Since August 2014, the national and local agencies had successively issued fines against many players in the automobile supply chain, including auto parts manufacturers, and motor vehicle suppliers and distributors due to resale price maintenance (RPM) practices. The aggregate antitrust fine in the auto sector has reached up to RMB 2.5 billion by November 2019.

According to China's antitrust 2019 annual report, vertical restrictions in the field of automobile circulation are believed to be very common due to a relatively advantageous position of auto suppliers (including manufacturers and general dealers). The report pointed out that the vertical price restrictions in the automobile distribution sector mainly include *fixing the sales prices* of new cars and parts for authorized dealers and repairers, *limiting the minimum sales price* of new cars and accessories for authorized dealers and repairers. In addition, there are also vertical non-price restrictions such as exclusive purchase agreements, regional restriction agreements, and tying agreements. The report also argued that vertical restriction in the auto sector not only undermines the order of competition in the auto distribution market but also seriously infringed on the legitimate rights and interests of consumers.

2.1.2 The 2014 Audi Case

Among all the prosecuted and convicted cases, the most well-known one is the antitrust case on the vertical monopoly of the Audi brand under FAW-Volkswagen (FAW-VW). On August 6, 2014, China's Anti-monopoly Bureau of the National Development and Reform Commission (NDRC) revealed to the public that there was evidence showing that FAW-Volkswagen Sales Co. and some Audi dealers had committed monopolistic practices related to price-fixing in March 2014 and an investigation has been launched since then. Though the commission did not disclose details, it announced that FAW-Volkswagen might be punished soon with a fine of

around 10 percent of its sales revenue. Along with the investigation, Audi announced a 22% price slashes for the engine of the Audi A6L.

On September 11, 2014, a penalty decision on FAW-Volkswagen Sales Co., Ltd. was made recently for entering into and implementing a vertical monopoly agreement with ten Hubei Audi dealers to maintain the prices of vehicle sales and service repairs from 2012 to 2014. According to the Hubei Provincial Price Bureau, FAW-Volkswagen's acts violated Article 14 of the Anti-Monopoly Law and were illegal acts of "fixing the price of reselling goods to a third party" and "limiting the minimum price of reselling goods to a third party". The fine was 248.58 million yuan (around 35.53 dollars) which accounts for 6% of the total sales revenue in the relevant markets.

In addition to FAW-VW and Audi, there are other manufacturers and brands investigated or fined by the national antitrust department due to the acts of vertical price restraints. They include the Fiat-Chrysler case on September 9, 2014, the Mercedes-Benz case on April 23, 2015, Nissan case on September 10, 2015, General Motors on December 23, 2016 and Chang'an Ford case in June 2019[1].

Among all the cases, Audi's price restraint antitrust event (called "the 2014 Audi event" in the following parts of this paper) was influential and marked a new era of China's antitrust enforcement in the automobile market because of the following reasons. First, it was the first time that China's antitrust authorities have issued numerous fines on a well-known joint venture auto manufacturer and popular brand to stop vertical price restraints. Second, it attracted much attention of the media and the public and the impacts of the event have initiated a wide discussion. Major news outlets across many countries covered the event and its aftermath. Audi's culpability quickly became a matter of public knowledge. Though the official objective of the event is to promote competition between the dealers and enhance consumers' welfare in the long run, many analysts believed that "the investigation and conviction would only lead to temporarily tentative small price cuts from the manufacturers presumably hoping to appease regulators and avoid anti-monopoly enforcement penalties"(Xinhua.com, People.com).

Despite the disagreements on the impacts of such antitrust events on the auto market,

[1]Details are included in the Appendix A.

there is very little empirical research studying it. In my paper, I assume the investigation announcement on Audi's vertical restraints act in August 2014 to be an exogenous shock to the auto market and investigate the impacts of the antitrust event by a difference-in-differences method.

2.1.3 China's Automakers and Dealers Relationship

Automobile manufacturers and their dealers have a strong vertical relationship in China. New cars can only be purchased from authorized car dealerships, known as 4S shops, which stand for sales, spare parts, services, and surveys. Consumers are required to maintain their cars at 4S shops during the warranty period; otherwise, the manufacturer may refuse to comply with the warranty. Additionally, authorized spare parts can only be obtained from 4S shops. In most cases, independent car dealers sell only used cars. Therefore, becoming an authorized dealer and maintaining a close relationship with the manufacturer are crucial for the business success of dealers.

In the vertical framework between automakers and dealers, automakers can use price control to prevent dealers from engaging in price competition and to foreclose independent dealers, a common practice among most brands. This practice of price control is more preferable to automakers than limiting the number of dealers, as the latter could result in a loss of market power against other brands. Moreover, automakers in China could easily implement price restraint strategies due to the absence of regulations on price restraints in the automobile industry before 2014.

2.2 Data

My analysis is based on three main data sets. The first data set comprises vehicle registration records from January 2010 to December 2015 across 34 cities in China. The second data set is sourced from China's largest auto website, Auto Home, and includes consumer-level self-reported vehicle transaction information covering 2010 to 2018 in multiple cities. The third data set consists of city-year level household demographics from 2010 to 2015, collected from the National Bureau of Statistics of China.

For the vehicle registration data, we observe monthly product-level vehicle registration information, including the manufacturer, brand, model name, total number of sales, major model attributes (fuel consumption, width, length), and the manufacturer's suggested retail price (MSRP) of a vehicle model from 2010 to 2015 in each city. Each observation in the data set represents a vehicle model defined by its brand name, year, and model type, e.g., Audi-Q3-2010-1.8 TFSI Comfort. Note that in the data set, we can only observe the MSRP, which provides a model-level suggested price invariant across markets, but not the transaction price. To address this issue, I employ an alternative measure of prices —MSRP plus the sales tax— for demand estimation, following recent studies (Li, 2018; Barwick, Cao and Li, 2021). This practice is valid because the MSRP in China is usually close to the actual transaction price.

For the consumer-level transaction data, it is often hard for researchers to observe due to data limitation. One innovative point in my paper is that I compile a data set of the consumer-level self-reported transaction data covering 2010 through 2015. This data set consists of individual consumer choices (car manufacturer, MSRP, brand, model name), transaction price, purchase time, and related dealer information (name and location) in Shanghai, sourced from China's largest auto information online platform, Auto Home. The data set includes 19,810 self-reported purchases from 2010 to 2015. I compare the registration data set with the transaction data and find that the two data sets are consistent with each other in terms of car manufacturers, brands, and models, as they come from the same market.

To facilitate the analysis, I match the transaction data set with the vehicle registration data using auto model-level characteristics (manufacturer, brand, model name, purchase time, MSRP, and fuel consumption). The data matching process demonstrates the robustness of the self-reported data for our analysis for the following reasons: First, there is at least one reported transaction for over 90 % of brands, which account for nearly 99% of all sales. Second, approximately 25% of sales, covering 80% of all sub-brands and 10% of observations (5,400) in the registration data, are observed in the transaction-level data sets in terms of sub-brand name (e.g., Audi A6L), MSRP (varying across model types), fuel consumption level (e.g., 1.4L), model year, and purchase time. Third, most mismatched data between the two data sets

is observed at the sub-brand level (e.g., Audi A6L) rather than the model type level, due to differences in car attributes[1].

For robustness checks in the revenue analysis, I use imputation methods to simulate the missing transaction prices. This involves regressing ln(transaction price/MSRP) on the time lags of purchase (purchase time-release time), model-level, and year-month fixed effects, and calculating the sales-weighted average transaction prices for each car model in a month. However, in this study, the imputation method is not a concern and does not affect my main analysis because I rely on the registration data and the self-reported transaction-level data (without imputed prices) separately in our regression results. Moreover, I use the observed and imputed transaction prices as a robustness check for the tracking pattern between transaction prices and MSRP in the demand estimation. I compare the MSRP and the transaction prices using transaction-level data, merged data and imputed data separately. The price data patterns described in our results are consistent across all samples, with or without the imputed data. The key variables in the registration data and the transaction data are listed in Table 1.

Table 1: Key Variables Comparison

	Obs.	Mean	Std.Dev.	Min	Max		Obs.	Mean	Std.Dev.	Min	Max
Reported transaction data						Registration data					
Time	58095	638.6	19.75	600	671	Time	19810	645.44	17.58	600	671
MSRP (10,000 RMB)	58095	17.06	13.07	2.08	500	MSRP (10,000 RMB)	19810	16.28	9.31	2.98	99.8
Transaction Price (10,000 RMB)	58095	30.2	99.69	0.5	3965	Number of sales in a month	19810	14.75	8.38	1	110
Manufacturer	58095	30.2	23.39	1	76	Manufacturer	19810	26.05	22.62	1	72
Brand (e.g. Audi)	58095	39.37	20.23	1	87	Brand	19810	43.59	19.37	1	73
Sub-brand (e.g. Audi A6)	58095	256.21	190.16	1	602	Sub-brand	19810	274.79	141.16	1	485
Model (e.g. Audi A6 2014 1.4L Comfortable Type)	58095	1193.53	736.83	1	2506	Model	19810	2802.43	1499.01	1	5220
Fuel consumption	58095	19.19	9.12	1	54	Fuel Consumption	19810	15.79	4.54	1	39
Electric Vehicle	58095	0	0.07	0	1	Electric Vehicle	19810	0.03	0.18	0	1
						Dealer	8429	146.48	81.39	1	285
						User	19810	12947.13	7539.55	1	26358
						Purchase One Year after Mdel Released	19810	0.3	0.46	0	1
						Price Discount - transaction price - MSRP	19810	-1.53	1.85	-19	11.41
						Percentage Discount - transaction price/MSRP	19810	0.91	0.09	0.1	2.33

I display summary statistics for the variables used in our analysis in Table 2. A typical observation in the sample is an Audi A6L "2014 1.4L Comfortable type" in August 2014. There are 58,905 observations in total in the sample. We could find that the mean manufacturer's suggested retail prices (MSRP) before the event is slightly lower than MSRPs after the event in general possibly as a result of quality provision. Note that all the variables in Table 2 come

[1]It's because the attributes' information on models in the two data sets are from different sources and sometimes not comparable with each other

from the registration data directly except that variables calculated based on transaction prices are imputed.

Table 2: Summary Statistics

	Before the Audi's event (< August-2014)					After the antitrust event (≥ August-2014)				
	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
ln(sales/outside option)	42667	-15.45	1.92	-17.71	-9.06	15428	-15.38	1.87	-17.71	-8.73
Manufacturer suggested retail price(10,000 RMB)	42667	16.47	12.73	2.08	112.78	15428	18.69	13.82	3.29	500
ln(MSRP+tax)	42667	2.53	0.62	0.67	4.66	15428	2.68	0.58	1.13	6.15
Number of sales in a month	42667	29.4	88.57	0.5	2832	15428	32.38	125.4	0.5	3965
Month-year	42667	629.82	15.25	600	654	15428	662.89	4.84	655	671
Sales weighted average transaction price (10,000 RMB)	42667	15.07	11.46	1.49	128.17	15428	16.31	11.26	1.92	119.19
ln(transaction price+tax)	42667	2.44	0.62	0.34	4.79	15428	2.55	0.58	0.59	4.72
Percentage price ratio (transaction price/MSRP)	42667	0.87	0.1	0.09	1.34	15428	0.83	0.1	0.22	1.25
Matched(not imputed)	2,593	0.06	0.23	0	1	1,352	0.08	0.27	0	1
Treated brands (Audi)	42667	0.02	0.13	0	1	15428	0.03	0.16	0	1
Treated manufacturers(FCA-VW)	42667	0.05	0.23	0	1	15428	0.07	0.26	0	1
Fuel consumption	42667	19.21	9.29	1	54	15428	19.13	8.62	2	54
Width (m)	42667	1.77	0.08	1.4	2	15428	1.79	0.06	1.5	2.02
Length (m)	42667	4.5	0.35	3.01	5.27	15428	4.56	0.29	3.4	5.55
Total shares of EVs sold in a market	42667	0	0	0	0.01	15428	0.08	0.05	0	0.21
Total population in a year(10,000)	42667	2393.11	57.77	2301.92	2467	15428	2460.68	7.07	2301.92	2467

Information on household demographics, including the total population and annual household income in Shanghai from 2010 to 2015, is sourced from the National Bureau of Statistics of China. The sales tax information is obtained from official regulations.

2.3 Descriptive Evidence

I first provide descriptive evidence on the impacts of Audi's event on the auto market. To graphically illustrate the impacts, I examine the trend of sales, MSRP, and average transaction prices over the treated group Audi, other brands of Volkswagen[1], Mercedes-Benz and BMW in Figure 1. The reason why I choose Mercedes-Benz and BMW as a comparison group are because Audi, BMW, and Mercedes-Benz are the top three popular luxury car brand in terms of both sales and prices[2].

A notable pattern illustrated in Panel (a) of Figure 1 is that the sales of the Audi brand increase sharply after the event while those of Mercedes-Benz and BMW do not exhibit a

[1] Audi is a brand operated under FAW-Volkswagen in China.

[2] Appendix B display sales and prices across brands over the sample period.

similar pattern. It implies that the antitrust event has an overall positive impact on the sales of Audi. The pattern may not be surprising because consumers may substitute their choices of other brands with Audi models because they expect a price reduction of Audi knowing the antitrust case. In addition, the event did not lead to significant sales changes of the other brands under FAW-Volkswagen.

In Panel (b) of Figure 1, I use the transaction-level data to document the trend of prices. The graph shows Audi's average transaction price and MSRP is significantly lower after the event. It is consistent with Audi's responses to the antitrust investigation. Interestingly, the prices of Mercedes-Benz and BMW also decreased slightly probably due to substitution effect or sample selection issue. Besides, we can tell that 1) transaction prices of all brands are always smaller or equal to MSRP; 2) the trend of MSRP and sales-weighted transaction prices are close to being parallel in the sample.

To understand the persistence of the event impacts, one key question is whether the event reshaped the vertical contracts between the automakers and dealers on the supply side. If the event had led to cost increases permanently and stopped vertical control, then we would have seen a larger deviation of transaction prices (set by dealers) from the manufacturer's suggested retail prices (set by automakers) after the event. I draw the trend on mean and variance of price ratios (defined by transaction price/MSRP) of different models under one brand using the reported transaction-level data set in Figure 2. Note that Lower price ratios and larger variance indicate strong pricing power of dealers and less vertical control in the market.

As illustrated in Panel (a) of Figure 2, the changes of average price ratio after the antitrust event are heterogeneous for different brands. We did not observe significant decreases in price ratios of Audi. Panel (b) of Figure 2 shows that the variance of price discounts did not increase significantly after the event. Stable variances of the price discounts imply that the event did not have a significant impact in stopping vertical control. Interestingly, the transaction-MSRP price ratio of Audi decreased sharply after April 2015. Some possible explanations are 1) Shanghai Free Trade Zone approved the parallel-imported channel of cars and thus lead to larger price competition between joint venture brands and the imported cars; 2) Mercedes-Benz's price restraint case is released on April 23, 2015, with the highest penalty

(350 million yuan) ever which signaled strong determination of China's central government to prevent vertical monopoly in the automobile market and thus increased the opportunity cost of vertical control.

In the next section, I examine the impacts of Audi's event on the prices and demand of Audi and Volkswagen using a difference-to-differences design.

3 The Short-term Impacts of the Antitrust Event on the Market Outcomes of Audi

In this section, I present the empirical evidence that the vertical restraint antitrust event indeed had a significant positive impact on the demand of the Audi brand using a combination of difference-in-differences and demand estimation methods. I show that the antitrust event increased the overall sales of Audi relative to other brands and decreased the average transaction prices compared with the control group. I then interpret the difference-in- differences estimates as a sum of the event effect and the substitution effect to clarify how they relate to consumer choices.

3.1 Diff-in-Diffs Evidence

I investigate the impacts of the antitrust event on the market outcomes of the Audi brand by implementing the difference-in-differences specification and estimating the following regression:

$$Y_{jt} = \alpha_0 \cdot A_t \times T_j + X_{jt}\beta + \eta_t + \xi_b + \epsilon_{jt}, \tag{1}$$

where Y_{jt} is a measure of market outcome which is set-up as quantity sales defined by $\ln \frac{s_{jt}}{s_{0t}}$, equilibrium prices or equilibrium price discounts; A_t is a binary indicator which equals 1 after the antitrust enforcement; T_j is a binary variable indicating the model j belongs to the treated brand(Audi) in the antitrust event; the vector X_{jt} controls for the observed product attributes of model j in the market t such as prices p_{jt} and fuel consumption level and a

constant; η_t denotes the year-month fixed effects; ξ_j controls the model-level (e.g. Audi-Q5-2010-1.4L-TSFI-Comfortable Type) fixed effects and ξ_{jt} is the error term. Here, the binary variable A_t and T_j are not included in the setup separately because they are captured by the fixed effects η_t and ξ_j. The coefficients of interest - α_0 capture average treatment effects of the antitrust event on the market outcomes of Audi models. I identify the parameters from the changes in the outcome variables of treated and control groups before and after the antitrust enforcement within the same market. The choices of the control group and underlying parallel trend assumption are addressed in Appendix B.

To understand how the event affects automakers and dealers of Audi, I first examine changes in average transaction prices and MSRP after the event, as shown in Table 3. In all the specifications of Table 3, I control for month-year fixed effects. In Column (1)-(4), I control for model-level fixed effects to mitigate the issue of omitted variables. In our main specification Column (1) and (2), I choose BMW as the control group for Audi in the difference-in-differences regression setup. BMW is a valid control group for three reasons: 1) Audi, BMW, and Mercedes-Benz are the top three popular luxury car brands in China, as shown in Appendix B; 2) BMW and Audi exhibit parallel trends in sales and prices before the event, as shown in Panels (a) and (b) of Figure 1; 3) among all the luxury car brands comparable to Audi, BMW is likely the least affected by the event because there were no investigation reports or negative news about the brand in and after August 2014[1].

I build my analysis on the estimates in Column (2) using BMW as a control group. The interaction coefficient α_0 in Column (1) and Column (2) are significantly negative with a value around 4-5% and the results are robust to the changes of control groups in Column (3)-(6). The results suggest that 1) Audi makers did decrease the MSRP of Audi models in response to the event as announced; 2) the dealers of Audi also decreased the prices, and thus we observe a decrease in the average transaction prices. One may be concerned that the imputation may damage our regression results. The data pattern depicted in Panel (b) of Figure 1 using transaction-level data (no imputed transaction prices included) is consistent with our

[1]There were reports that Mercedes-Benz was also investigated starting in July 2014, though no official report was released.

Table 3: Diff-in-Diffs Regression Results on Prices

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	$\ln(tprice)$	$ln(MSRP)$	$\ln(tprice)$	$\ln(tprice)$	$\ln(tprice)$	$\ln(tprice)$
α_0 Antitrust =1 × Audi	-0.0414**	-0.0469**	-0.0421**	-0.0317*	-0.0402***	-0.0356***
	(0.0190)	(0.0199)	(0.0186)	(0.0167)	(0.0135)	(0.0134)
Control Group	BMW	BMW	BMW &Cadillac	BMW & Benz	All JV Brands	All Brands
Car attributes	YES	YES	YES	YES	YES	YES
Sub-brands level fixed effect	YES	YES	YES	YES	YES	YES
Month-year level fixed effect	YES	YES	YES	YES	YES	YES
Observations	3,259	3,259	3,516	4,390	40,017	57,816
R-squared	0.564	0.522	0.571	0.620	0.944	0.948

regression results.

Next, I examine whether the antitrust enforcement led to changes to the demand of Audi using a diff-in-diffs method. I implement the difference-in-differences specification in a logit framework using $\ln(\frac{s_{jt}}{s_{0t}})$ as a measure of consumers' utility evaluation of car models. Here I define the market size as the total number of population in the city in the specific year and the number of outside options s_{0t} equals to the market size subtracts the total number of model sales in the month-year market.

Table 4 summarizes the regression results on mean utility from the difference-in-differences setup. Similar to the previous analysis, I control for month-year fixed effects. Additionally, I control for model-level fixed effects to absorb unobserved product attributes and address endogeneity issues. This approach, which incorporates unobserved product attributes and household-invariant observed product attributes into the mean utility function through model-level fixed effects, was introduced by Berry, Levinsohn and Pakes (1995) and further elaborated in subsequent studies (Li, 2018; Barwick, Cao and Li, 2021).

I build my analysis on the estimates in Column (2) using BMW as a control group. The estimates of α_0 from diff-in-diffs regression in Column (2) capture the impacts of the antitrust event on the mean utility of Audi brand: utility evaluation for Audi increased by 84% overall after the antitrust event holding prices and other variables unchanged. The positive interaction term captures a positive demand shift to Audi led by the antitrust event but not a negative scandal

Table 4: Regression Results on Mean Utility

VARIABLES	(1) $\ln \frac{s_{jt}}{s_{0t}}$	(2) $\ln \frac{s_{jt}}{s_{0t}}$	(3) $\ln \frac{s_{jt}}{s_{0t}}$	(4) $\ln \frac{s_{jt}}{s_{0t}}$	(5) $\ln \frac{s_{jt}}{s_{0t}}$	(6) $\ln \frac{s_{jt}}{s_{0t}}$
α_0 Antitrust =1 × Audi	0.616***	0.613***	0.518***	0.643***	0.589***	0.644***
	(0.161)	(0.160)	(0.156)	(0.143)	(0.132)	(0.132)
Control Group	BMW	BMW	BMW& Benz	BMW& Cadillac	All JV Brands	All Brands
Car attributes	YES	YES	YES	YES	YES	YES
Model level fixed effect	YES	YES	YES	YES	YES	YES
Month-year level fixed effect	YES	YES	YES	YES	YES	YES
IV		YES	YES	YES	YES	YES
Observations	3,251	3,251	3,508	4,382	40,017	57,816

shock. The possible reasons are 1) Audi not only lower the prices of some new car models but also announced a price cut in some auto parts which would decrease the maintenance cost and increase the evaluation of Audi; 2) the public announcement made by the national authority became a free advertisement for Audi and increase the value evaluation of Audi brand since the brand made a timely and sincere response.

In Column (3) and (4), I add Benz and Cadillac[1] into the control group control respectively. Results in Column (2) and (4) are similar, indicating that the coefficients are robust to the changes of the control group. We find that the interaction coefficient α_0 in Column (3) where I include Mercedes-Benz into the control group is slightly smaller than the baseline coefficient in Column (2). It's consistent with our findings because it indicates that the impacts of the antitrust event on Mercedes-Benz slightly offset the estimated coefficient α_0 in Column (2) as Mercedes-Benz is also one of the "targets" of the antitrust event. In Column (1), I use average transaction prices in place for MSRP to check the differences between the estimation results. The interaction coefficient U0 is invariant to the prices though the price coefficient on transaction prices is captured by model-level fixed effects in Column (1). I check the results using Hausman instrument variables in Column (7) and the signs of all coefficients remain the same. In the analysis above, I rule out the possibility of simultaneous demand shock due to

[1]The choices of these brands are explained in Appendix B

the following reasons: 1) the impacts are significant at a monthly level; 2) the results hold in the sub-sample of different control groups.

3.2 Event Study Analysis

In addition to equation (1), I also estimate an equation using an event study specification to examine the heterogeneous impacts of the Audi event. The setup is as follows:

$$Y_{jt} = \sum_{k=-10}^{-2} \alpha_k \cdot A_{t+k} \times T_j + \sum_{k=0}^{10} \alpha_k \cdot A_{t+k} \times T_j + X_{jt}\beta + \eta_t + \epsilon_{jt}, \tag{2}$$

where T_j denotes the binary indicator of the treated group which equals 1 if model j belongs to the treated brand group, 0 otherwise. Different from the diff-in-diffs method, α_k in this framework captures the temporal impact of the antitrust event on the market outcomes. The estimation results using a sub-sample of Audi, BMW, and Cadillac brands were illustrated in Figure 3. Panel (a) in Figure 3 displays the event study results on transaction prices. It shows that: 1) transaction prices of Audi decreased significantly immediately after the event; 2) the prices bounced back one month after the penalty decision.

Panel (b) in Figure 3 shows that (1) the utility evaluation of Audi decreased slightly when the national antitrust department announced the investigation and conviction due to either "scandal" effects or intertemporal substitution of consumers' choices; (2) the utility evaluation of Audi bounced back one month after the national antitrust authority made a penalty decision, with positive impacts persisting for a few months after the event. The substitution pattern is intuitive, as it implies that consumers chose to wait for the anticipated price reduction or discount on Audi models after the event, rather than purchasing other models. The positive effects of the event on Audi's sales suggest that the benefits from the antitrust event outweighed the negative "scandal" effects.

In conclusion, I find that: 1) In the short term, automakers responded to the antitrust event by offering tentative small price cuts on some new car models and auto parts. 2) From the demand side, the event itself led to unexpected utility increases for the Audi brand, holding prices and other variables constant.

4 Persistence of the Event Impacts

In this section, I investigate the persistence of the antitrust event impacts by checking the relationship between transaction prices and MSRP. I use the ratio defined by transaction prices over MSRP as a measure of vertical control level following the idea of Li (2018) that transaction prices would follow MSRP if vertical price control exists in the market. I check the average treatment effects on the price ratio following the diff-in-diffs model setup in equation (1)

Table 5 summarized the regression results. We find that the coefficient α_0 on the interaction term is not significant in all the regressions controlling time and model fixed effects. The finding is consistent with the descriptive pattern illustrated in Figure 2 suggesting the pattern that transaction prices track MSRP keeps the same even after the antitrust event.

Table 5: Diff-in-Diffs Regression Results on Price Discounts

	(1)	(2)	(3)	(4)	(5)
VARIABLES	$\ln(\frac{tprice}{MSRP})$	$\ln(\frac{tprice}{MSRP})$	$\ln(\frac{tprice}{MSRP})$	$\ln(\frac{tprice}{MSRP})$	$\ln(\frac{tprice}{MSRP})$
α_0 Antitrust =1 × Audi	0.00546	0.00597	0.00767	0.00575	0.00628
	((0.00804)	(0.00792)	(0.00739)	(0.00588)	(0.00588)
Control Group	BMW	BMW &Cadillac	BMW & Benz	All JV Brands	All Brands
Car attributes	YES	YES	YES	YES	YES
Sub-brands level fixed effect	YES	YES	YES	YES	YES
Month-year level fixed effect	YES	YES	YES	YES	YES
Observations	3,259	3,516	4,390	40,017	57,816
R-squared	0.471	0.477	0.529	0.537	0.534

5 Interpretations of Results

In the following interpretation, I first make the following assumptions on the supply side in the context of China's auto market: 1) automakers are in an oligopoly market and every brand

owns a certain oligopoly power[1]; 2) the event did not lead to changes in production cost. Then, I provide the possible interpretation of the results:

First, a decrease of 4.69% in MSRP estimated in Table 4 shows that Audi as an auto brand did follow its announcement and cut the MSRP of some models in response to the antitrust event.

Second, the finding that dealers cut similar amounts (4.14%) of the average transaction prices as the MSRP decrease suggests 1) there should be no double marginalization happening after the event. In other words, the dealers did not have monopoly power over the market even after the event. If double marginalization happened after the vertical restraints antitrust event, then dealers would have increased the transaction prices for a higher markup; 2) dealers are in a "relatively" competitive market as the decreases in the "cost" parameter (reflected in the automakers' pricing - MSRP) were transferred to the transaction prices. In other words, the market prices of cars should be equal to the marginal cost if free entry and exit are allowed and no price control happens[2]. However, it would be another story when it comes to the persistence of the antitrust event in our context. Though the national antitrust authority targeted automakers' price restraints over the dealers during the antitrust investigation, exclusive deals and incentive contracts are still common and explicit in the supply-side market. It means that automakers could still use indirect ways such as stopping offering car models or price rebates (increase the cost) to control the entry and exit of dealers to some extent even if the antitrust event successfully stopped vertical control through direct ways such as fixing resale price.

Third, it is likely that the antitrust event did not change the vertical relationship between dealers and automakers as we find a persistent price ratio between MSRP and the transaction prices invariant to the antitrust event. Had vertical control had collapsed after the event, we would have seen more price drops.

Fourth, an interesting point we see from the difference-in-difference regression results is

[1]The assumption is commonly used in the study of China's auto market and also supported by our results. Suppose automakers are in a competitive market, an upward demand shift of Audi would have led to increases in both prices and sales holding the supply unchanged. However, we observe a price decrease and sales increase in the sample.

[2]This is consistent with the fact that there were many dealers in Shanghai during the sample period.

that there is an upward quantity shift of Audi after the event. The unexpected positive demand shock is captured by the interaction coefficient in the logit framework controlling prices and substitution patterns between brands. It is out of scope of impacts of the antitrust event, but it may not be surprising due to three reasons: 1) Audi lowered MSRPs for new cars as well as the engine prices for some models which would lower the maintenance cost of Audi models and may lead to higher utility evaluation for Audi brand; 2) Audi made timely and sincere responses to the antitrust case and applause not only the regulators but the public immediately after the national announcement. The responses made the event become free advertising instead of a scandal for Audi; 3) the consumers who are skeptical about car prices may believe that prices of Audi models are reasonable and legally regulated after the event.

Based on our assumptions, I interpret the price impacts of the event as a temporary market enhancement because it shifts the monopoly price of Audi lower towards the competitive price at the automaker's level. I hypothesize that Audi fixed the minimum resale price of dealers using a monopoly price to realize profit maximization before the event. After the event, Audi had to cut the monopoly price and decrease its profit. From this perspective, consumers would gain more surplus after the event. However, things become different as the event also led to some unexpected positive demand shift of Audi. Considering the unexpected upward demand shift of Audi after the event, the lowered price of Audi may be an equilibrium monopoly price. To check the idea, I illustrate the revenue changes of Audi before and after the event in Figure 4. Ideally, the revenue could be a proxy for profits holding the cost unchanged. As displayed in Figure 4, the revenue of Audi after the event was slightly higher than the revenue before possibly due to the unexpected upward demand shift. However, we also observe the revenue increase of other brands. Assume that the profit with resale price-fixing should not be lower than the counterfactual profit without resale price fixing holding demand the same, the revenue increase of other brands in Figure 4 means the event did not lead to changes in the vertical relationship as expected.

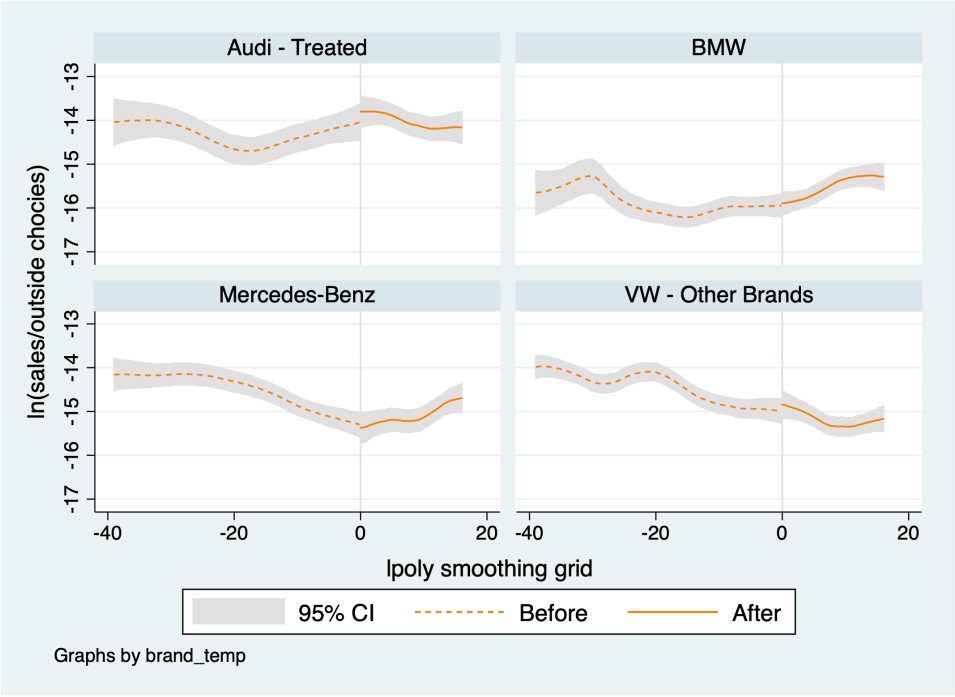
6 Conclusion

In this paper, I first investigate the short-term impacts of China's first vertical restraint antitrust case in the auto market on the market outcomes of the treated brand - Audi. The difference-in-differences evidence shows that the antitrust case led to MSRP and transaction price decreases of Audi and also caused an unexpected upward demand shift of Audi brand. Then, I examine whether the vertical restraint antitrust event stopped vertical controls as expected by checking the changes of the price ratio defined by transaction prices (set by dealers) over MSRPs(set by automakers). I find that changes in price ratio are insignificant after the event indicating that the antitrust event may not stop vertical control in the market. Overall, I interpret the impacts of the event as a temporary market enhancement in the automakers and dealers market as the event did lead to a price decrease in the oligopoly automakers' market. However, no evidence in our analysis shows that price decreases on the supply side are persistent.

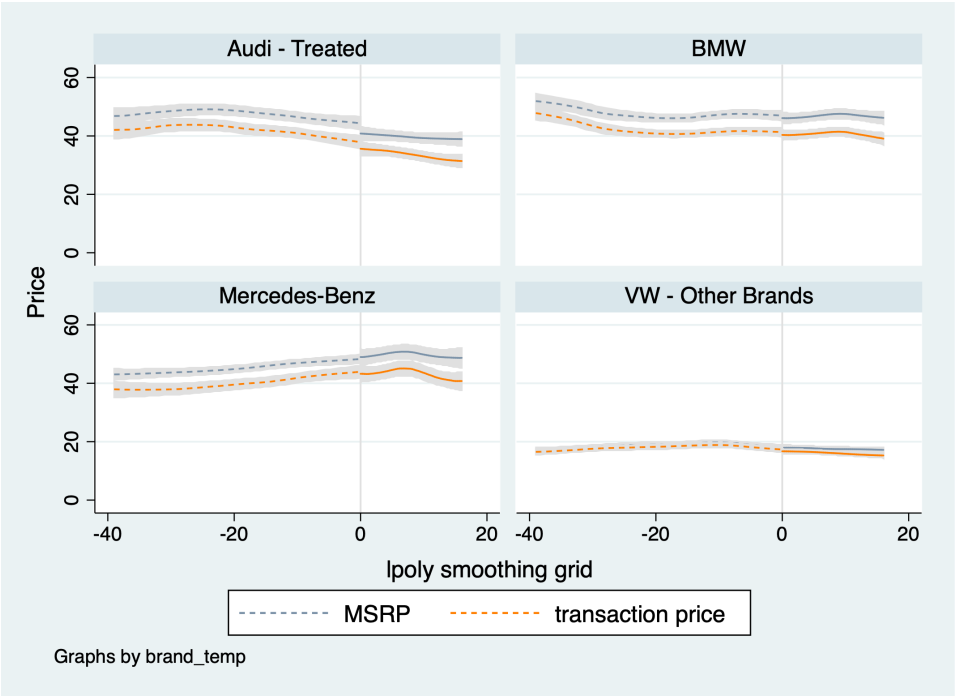
Though I study the short-term impacts and persistence of the antitrust event, there are a few limitations of this study. First, I do not consider the possible spillover effects of the event on our control brands which may lead to underestimates of the impacts on the market outcomes of Audi. To be specific, I explicitly assume BMW as a control group was free from being affected by the antitrust event as we did not observe any public news or significant sales changes of BMW. However, it's possible that BMW also responded to the event or was affected by the event. Our diff-in-diffs estimates based on these control groups may be lower than the true impacts. Second, in my paper, I use the ratio of transaction prices over MSRP to measure the vertical relationship and conclude that the event did not lead to changes of vertical relationship based on the unchanged price ratio and the assumption of no production cost changes. To be more careful, we may need to check whether the event led to cost changes in other ways. For example, the event led to the increases in the managerial cost of automakers. To fix the problem, we may build up a supply-side structural model and back out the cost parameters to check if the event leads to cost shifts. Third, I did not show whether the market equilibrium changes after the event. Though I showed the impacts of this antitrust event on demand and

prices are likely to be one-shot, I did not show how the impacts die out over time.

Figure 1: Sales and Transaction Prices Pre- and Post-Trend Comparison



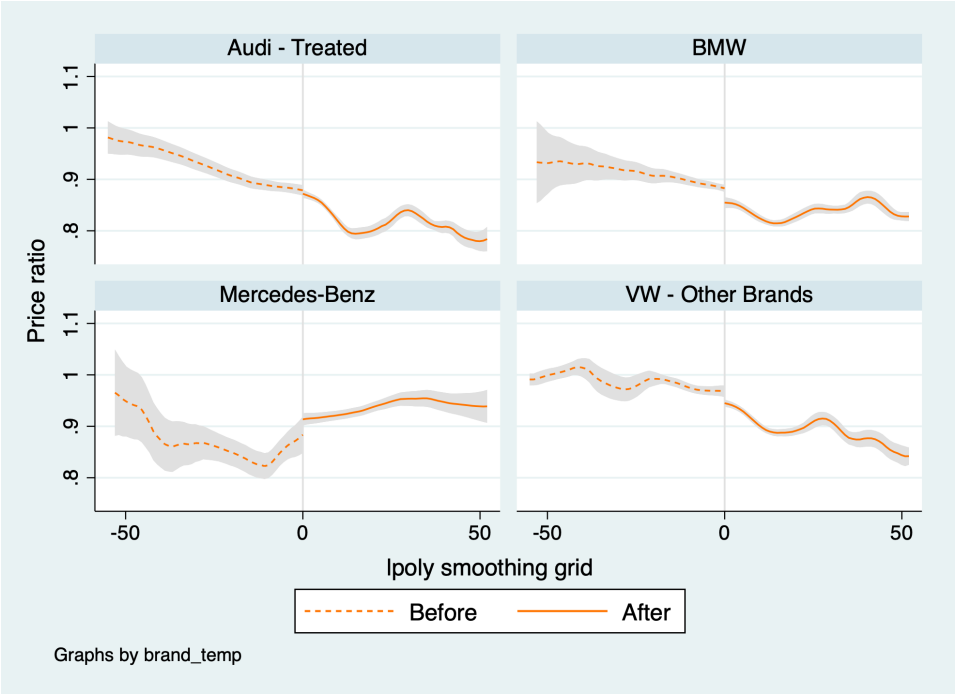
(a) Sales



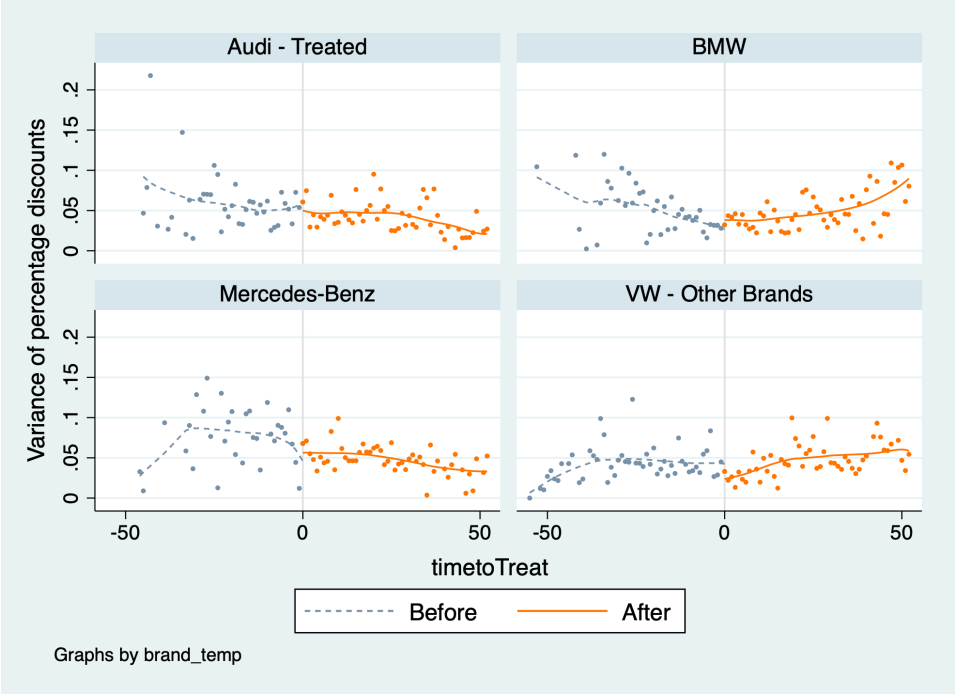
(b) Transaction prices and MSRP

***Note**: Panel (a) draws the monthly sales weighted average MSRP before and after the event. I use the sample from the vehicle registration data and exclude the new models released in 12 months before or after the event. In Panel (b), we use transaction-level data to check the trend of average transaction prices which could keep the pattern from being affected by the data imputation.*

Figure 2: Mean and Variance of Price Discounts



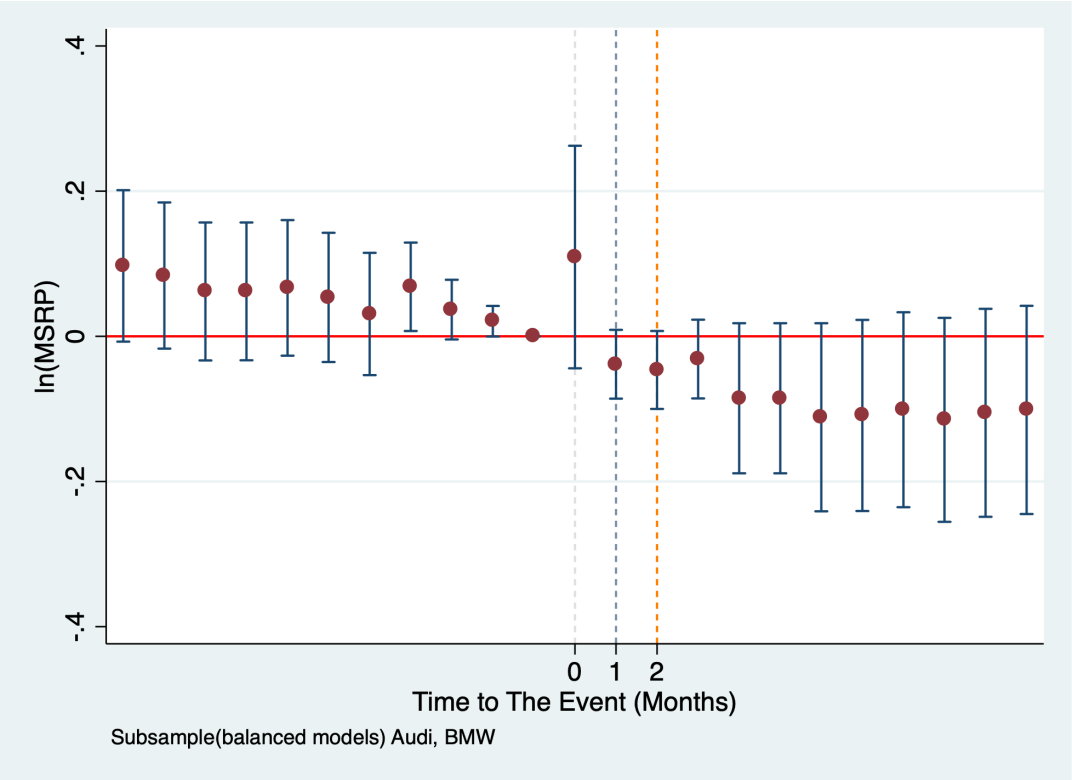
(a) Mean



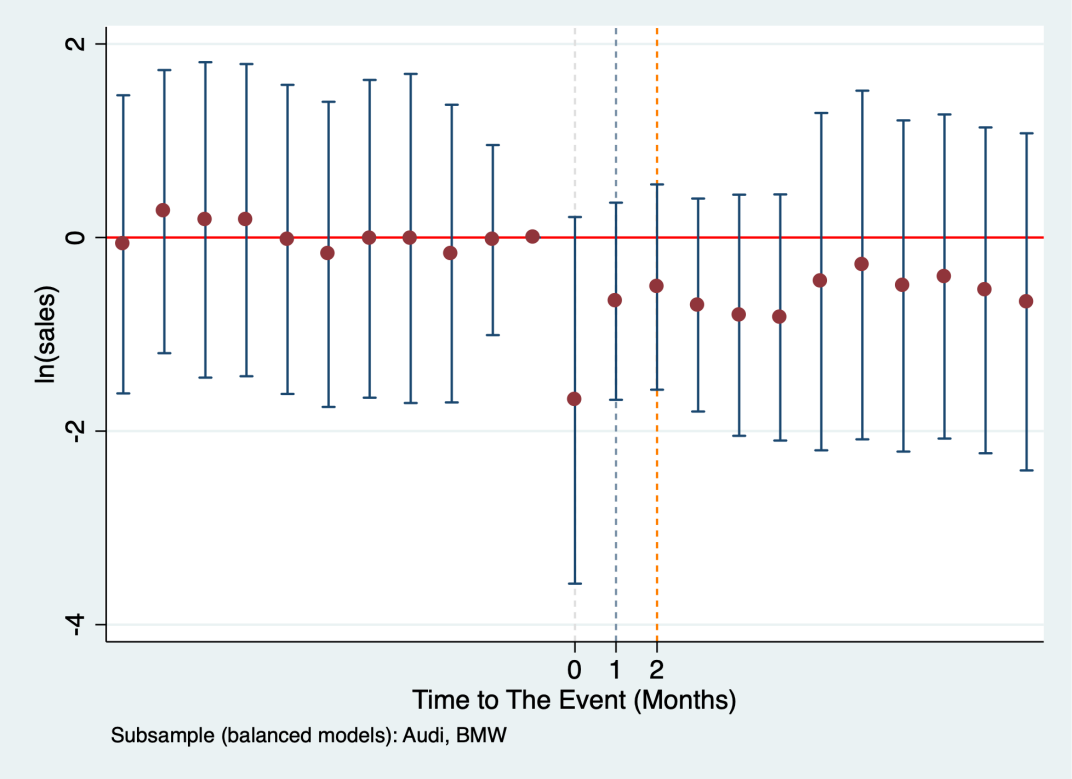
(b) Variance

***Note**: Panel (a) displays the average price ratios (transaction price/MSRP) using the transaction data in the 6-year window period. Panel (b) draws the variance of transaction price over MSRP ratios using the transaction data in the 6-year window period.*

Figure 3: Event Study on MSRP and Sales

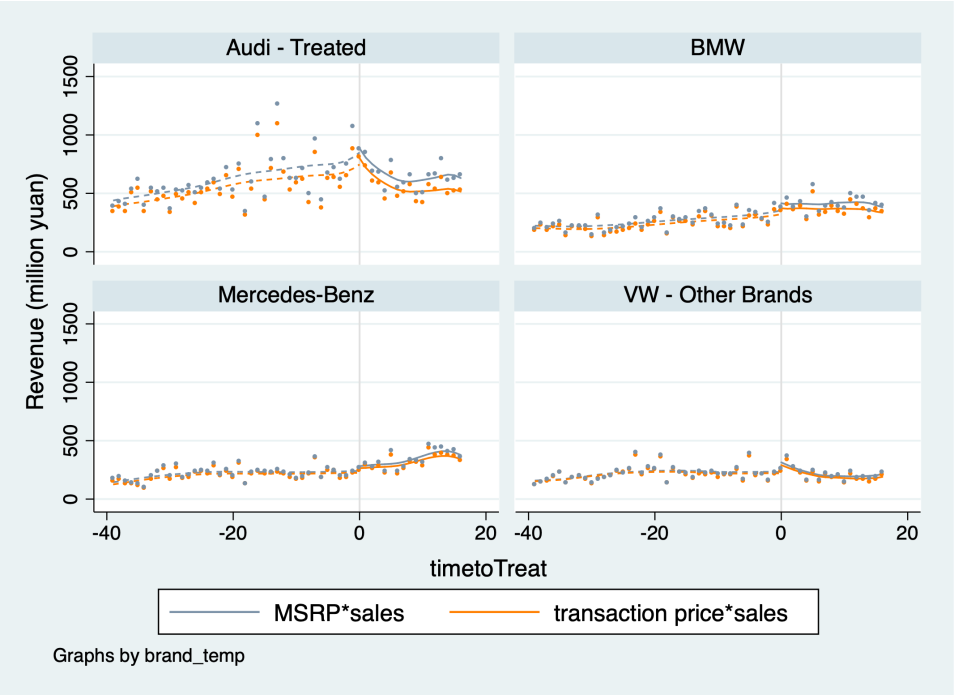


(a) MSRP



(b) Sales

Figure 4: Trend of Total Revenue



***Note**: I use the product of sales and prices to calculate the monthly revenue of different brands.*

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A Background Information

In addition to FAW-VW and Audi, there are other manufacturers and brands investigated or fined by the national antitrust department due to the acts of vertical price restraints. They include the Fiat-Chrysler case on September 9, 2014, with a penalty of 31.46 million yuan (approximately $4.66 million), the Mercedes-Benz case on April 23, 2015, with a penalty of 350 million yuan (approximately $51.47 million), Nissan case on September 10, 2015, with a penalty of 123.3 million yuan (approximately $18.09 million), General Motors on December 23, 2016, with a penalty of 201 million yuan, Chang'an Ford case in June 2019 with a penalty of 162.8 million yuan, and Toyota case on December 27, 2019, with a penalty of 87.61 million yuan.[1] Several other manufacturers—Jaguar Land Rover, Toyota, Honda, and BMW—reportedly resolved the investigation without formal penalties by announcing price cuts for cars or spare parts (Qiao, 2017). According to China's 2019 Annual Antitrust Report, most investigations on the cases (except Audi, Chang'an Ford, and Toyota) were initiated in August 2014.

[Mercedes-Benz Case] On April 23, 2015 - Jiangsu Provincial Price Bureau announced "Mercedes-Benz restricted the minimum resale prices of E-Class and S-Class complete vehicles in different regions of Jiangsu Province between January 2013 and July 2014 by telephone, verbal notification or by holding dealer meetings. And before that, its dealers in Suzhou, Nanjing, and Wuxi held several regional meetings organized by Mercedes-Benz at different periods to reach and implement a monopoly agreement to fix the prices of some parts". The implementation of the monopoly agreement by various means, including increasing the assessment of dealers, interviewing and warning dealers who did not implement the price limit policy, and reducing policy support led to the biggest anti-monopoly fine for Chinese auto companies - 350 million RMB and 7.869 million RMB for some dealers (BBC.com). According to People.com, the main illegal facts of Benz include: reaching a monopoly agreement to *limit the price of sales and put it into practice.* The investigation showed that as early as 2010, Mercedes-Benz limited the minimum price for resale of Mercedes-Benz car-related parts by

[1]Details are included in the Appendix A.

dealers in the province, and *implemented a price limit policy of no less than 30%, 20% and 10%* respectively according to different situations such as accident cars (insurance company claims), discontinued models (outside the warranty period) and in-production models (within the warranty period). Administrative penalty decision to prove 6, time, place, people, the elements of the circumstances of the violation of the law a lot. For example, on April 17, 2014, and May 9, 2014, a regional manager of Mercedes-Benz organized a meeting of Nanjing dealers to clarify the invoiced prices for all levels of vehicles and to implement the existing price limit policy for the Mercedes-Benz E-Class and S-Class models. As revealed by China's 2019 annual antitrust report, Mercedes-Benz also requires dealers to upload the sales invoices of E-Class and S-Class vehicles every week. For dealers who violate the price limit policy, the manufacturer would reduce the policy support, such as stopping the supply of hot models, stopping the approval of new store projects; for dealers related to the responsible personnel to interview, it requires dealers to dismiss them from the Mercedes-Benz distribution system.

[Chang'an Ford Case] According to China's antitrust 2019 annual report, it was found that *from 2013 to 2017*, when Chang'an Ford sold "Ford" brand cars in the Chongqing area, it required dealers to sign the "Chang'an Ford Chongqing Area Dealer Price Specification" by formulating and issuing a "Price List". The company formulated and issued a price list, required dealers to sign the "Chang'an Ford Chongqing Dealer Price Regulation Agreement", formulated price policies during auto shows, and restricted the lowest price offered by dealers on the network to limit the minimum resell price of the whole vehicle to a third party. The investigation shows that downstream dealers have implemented to limit the minimum resell price of the whole vehicle to a third party Chang'an Ford's minimum resale price requirement; for dealers who did not implement the minimum resale price requirement, Chang'an Ford has imposed penalties on dealers who do not enforce the minimum resale price requirement.

In August 2015, the National Development and Reform Commission (NDRC) interviewed Chang'an Ford Motor Company Limited (hereinafter referred to as Chang'an Ford) based on a peripheral investigation and requested Chang'an Ford to conduct a self-examination of its business practices. In December 2017, an anti-monopoly investigation was conducted against Chang'an Ford under the law. Considering Chang'an Ford's active cooperation with

the investigation and timely rectification, the nature, extent, and duration of Chang'an Ford's illegal behavior were taken into account. On May 22, 2019, the General Administration of Market Supervision made an administrative penalty decision by Articles 47 and 49 of the anti-monopoly law, ordering Chang'an Ford to stop limiting the minimum price of goods resold by dealers to third parties. The administrative penalty decision was issued by the General Administration of Market Supervision on May 22, 2009, by Articles 47 and 49 of the Anti-monopoly Law. The administrative penalty was imposed on Chang'an Ford to stop the illegal act of limiting the minimum price of goods resold by dealers to third parties and to impose a fine of 4% of the 2016 sales of 4.07 billion yuan in Chongqing, totaling 162.8 million yuan.

[Toyota Auto] According to China's antitrust 2019 annual report (page 31), Toyota Auto unifies the interaction between dealers in Jiangsu Province by holding dealer meetings, store tours, and WeChat notifications from June 2015 to February 2018. The online platform sells the online quotation of Lexus cars and limits the resale price of some models of the whole vehicle, requiring dealers not to lower the price. Toyota's actions limit price competition among dealers and deprive dealers of their pricing power, which damages the legitimate rights and interests of consumers, violates Article 14 of the Anti-Monopoly Law, which prohibits fixed or limited regulations on the price or minimum price for resale of goods to a third party. Jiangsu Provincial Administration for Market Regulation made actions following the law. The administrative penalty decision ordered Toyota to stop the illegal act and imposed a fine of 2% of its sales in the previous year, totaling 87.6131 million yuan.

B Choices of Control Group

Figure 5: Total Sales and Average Prices of All Brands during 2010-2015