大規模災害時の中古車需要に関する研究

The impact of the Great East Japan Earthquake and Tsunami on the Used-Car Market

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ABSTRACT

The object of this study is to show how the Great East Japan Earthquake and Tsunami of 2011 impacted on the used-car market in the disaster-stricken area. We compared the used-car prices in the disaster area with those in Tokyo by applying the Hedonic model. Our findings show that Light Motor Vehicle Cab Vans, Light Motor Vehicle Trucks, and Mini Van and One-Box cars were in demand in the disaster-stricken area. In comparison with our previous study, the current study suggests the robustness of higher demand for Light Motor Vehicle Cab Vans and Light Motor Vehicle Trucks after the disaster in the disaster-stricken area. Furthermore, this study might suggest that less expensive body types might have been most in demand soon after the disaster. On the other hand, more expensive body types might have been in demand several months after the disaster.

Key words: *Used-Car market, Used-Car demand, Disaster, Great East Japan Earthquake and Tsunami*

1 Introduction

When a water-related disaster happens, the demand for used cars generally goes up. For example, Hurricane Harvey and Irma in 2017 caused increased demand for used cars around the flooded areas (Breuninger, 2017; Chee, 2017; Lang, 2017). Likewise, after the Great East Japan Earthquake and Tsunami, there was great demand for used cars in the disaster-stricken area. Our previous study (Shibuya & Tanaka, 2017) statistically showed that there was increased demand for used cars by comparing used-car prices in the disaster area and non-disaster area. This study aims to deepen the understanding of used-car demand after the disaster with the widened data. More specifically, in the previous study, we compared the price of used cars in the damaged area, Miyagi and Iwate prefectures, and those of Chugoku area[1] as an example of a non-damaged area. In this study, we analyze the used-car price differences between the damaged area and Tokyo, the place with the most developed transportation connection system.

2 Related Literature

After the Great East Japan Earthquake and Tsunami, numerous newspapers reported that there was an increase in demand for used cars, particularly Light Motor Vehicles[2] in the disaster area (Asahi Shinbun, 2011; Mainichi Shinbun, 2011; Nikkei Sangyo Shinbun, 2011; Yomiuri Shinbun, 2011). In addition, our previous study reveals how a large-scale water-related disaster impacts on the used-car market (Shibuya & Tanaka, 2017). Shibuya & Tanaka (2017) applied the Hedonic Model which is widely used to analyze both used- and new-car price data (e.g., Haan & Boer, 2010; Kihm & Vance, 2016; Prieto et al., 2015). The Hedonic Model is an economic model that postulates that the price of a product reflects the bundle of embodied characteristics, such as engine type, engine volume, kilometers driven, and age (Prieto et al., 2015). With the Hedonic Model, Shibuya & Tanaka (2017) compared the used-car data in Miyagi and Iwate prefecture as the disaster-stricken area[3], and in Chugoku area as an example of a non-damaged area. The result shows that there was excess demand for Light Motor Vehicle Cab Vans (LC), Light Motor Vehicle Trucks (LT), and Light Motor Vehicle RVs (LR). In our previous study, we compared the disaster-stricken area's data with Chugoku area because Chugoku area is geographically far from the disaster area on the assumption that there was almost no disaster impact on its economy. Furthermore, Chugoku area is comparable with the disaster area in terms of economic size, population, and vehicle usage (Table 1).

In this study, with the aim of deepening the understanding of the demand for used cars after the Great East Japan Earthquake and Tsunami, we compared the used-car data in the disaster area and Tokyo. Tokyo is chosen because public transportation systems are prevalent, and a few households have automobiles unlike the disaster area (Table 1).

Table 1. Numbers of automobiles per household (as of March 2010)

	Automobiles per household	Light Motor Vehicle per household
The disaster area (Miyagi prefecture and Iwate prefecture)	1.311	0.668
Chugoku area	1.209	0.711
Tokyo	0.490	0.109
National average	1.080	0.499

Source: made by the author based on Automobile Inspection & Registration Information Association (2010) and Light Motor Vehicle Inspection Organization (2010)

1 Chugoku consists of five prefectures; Yamaguchi, Shimane, Tottori, Hiroshima, and Okayama
2 A Japanese category of vehicles whose engine volumes are 660cc or less.
3 Fukushima prefecture was also one of the most damaged areas but was excluded from our target data because Fukushima prefecture was suffered more from Fukushima Daiichi nuclear disaster and should be analyzed separately.

3 Data

To analyze the demand for used cars after the Great East Japan Earthquake and Tsunami of 2011, this paper uses Japanese used-car data in Iwate and Miyagi prefectures, and Tokyo. The used-car data were sourced from the advertisements posted on one of the most major used-car magazines in Japan, 'Goo' which is published half-monthly. This study uses the used-car data in Miyagi, Iwate, and Tokyo from January 2010 to March 2012[4]. After the disaster, 'Goo' suspended publication of the issue for the first half of April in the disaster area. In total, we analyzed data of 54 issues covering a three-year period (January 2010 to March 2012). Table 2 describes the used-car real prices[5] and numbers of used cars in Tokyo, and the disaster area (Iwate and Miyagi) for each body type[6].

Table2. Real prices and numbers in Tokyo and Disaster area (the three years of data pooled)

Body type	Tokyo					Disaster Area				
	Number of used cars	Real Price				Number of used cars	Real Price			
		Mean	min	max	std		mean	min	max	std
Cab Van (CV)	6,087	1,118,153	82,136	4,620,123	762,906	3,306	1,345,389	92,402	4,809,866	881,765
Coupe Sports Specialty (CS)	7,355	1,648,143	30,769	22,633,745	1,944,964	4,659	949,326	92,308	8,735,868	817,912
Hatch Back (HB)	22,758	796,218	40,041	10,133,333	484,473	25,418	624,020	40,082	10,483,042	393,265
Hard Top (HT)	4,845	729,811	18,499	5,066,735	710,820	4,621	721,171	30,832	4,516,427	604,766
Light Motor Vehicle Others (LA)	8,452	605,862	30,769	2,047,083	326,628	14,216	512,082	28,659	2,032,854	289,944
Light Motor Vehicle Cab Van (LC)	3,751	551,494	30,706	1,932,169	287,568	2,894	495,236	30,801	1,504,606	259,027
Light Motor Vehicle RV (LR)	33,058	691,773	40,000	2,672,148	384,515	66,897	618,529	38,895	8,193,018	329,859
Light Motor Vehicle Truck (LT)	2,232	521,839	51,335	2,877,698	310,702	3,840	500,106	41,068	2,548,818	255,402
Mini Van & One Box (MO)	63,390	1,146,132	28,747	7,985,612	847,968	71,624	890,311	30,769	11,510,791	616,870
Sedan (SD)	28,898	1,752,452	39,014	15,352,098	1,435,981	19,298	1,120,915	41,026	11,372,308	828,813
SUV & Cross Country & Light Cross Country (SU)	15,181	1,624,696	59,609	10,030,706	982,546	15,741	1,280,281	71,869	7,985,612	782,489
Truck (TR)	4,444	1,417,148	154,004	5,199,591	883,285	3,820	1,543,555	162,051	5,118,191	812,834
Wagon (WG)	11,857	845,257	20,513	4,851,129	675,834	11,169	691,677	30,832	3,446,154	556,898

4 Methodology

To analyze the price difference between the disaster area and Tokyo, the Hedonic Model that our previous research (Shibuya & Tanaka, 2017) used is applied to the current study. We use the following equation:

$$\ln P_i = \beta_0 X_i + \beta_1 R_i + \varepsilon_i \tag{1}$$

where $\ln P_i$ is the natural logarithm of real price of the *i* product, X_i is a vector of observable characteristics of the used cars, R_i is a regional dummy that reflects whether the car was listed in the disaster area (the disaster area = 1, Tokyo = 0), and ε_i is the error term. We can look into R_i to analyze the price differences between the disaster area and Tokyo area by controlling the used-car prices with observable characteristics of the used-cars based on the hedonic approach.

For the control variables X_i, we use the followings:

Transmission:
X_{1i} = Transmission dummy (Automatic = 1, others = 0)
Fuel:
X_{2i} = Diesel dummy (Diesel = 1, others =0)
X_{3i} = Gas Hybrid dummy (Gas Hybrid = 1, others = 0)
X_{4i} = EV dummy (EV = 1, others = 0)
X_{5i} = Other fuels dummy (LPG, CNG or FC = 1, others = 0)
Age:
X_{6i} = Age (in years)
Kilometers driven:
X_{7i} = 100,000km dummy (over 100,000km driven = 1, others = 0)
Engine Volume:
X_{8i} = Engine volume (cc)

In total, this paper uses a model with 8 control variables to estimate the regional dummy R_i[7]. Table 3 shows the correlations of independent variables for the three-year data pooled for all body types. To analyze which body types were most in demand and the time period when used cars were most in demand, we calculate the coefficients of R_i by applying equation (1) for each of the body types and each half-month issue separately. Table A1 in the Appendix presents basic statistical summary for equation (1) for all body types. As regards the second half of April in 2011, the numbers of all body types except MO and LR in the disaster area were much less than other time period (around 50 or less). The numbers of CV

4 'Goo' also has an online platform of used-car advertisements but we only analyze their paper magazine's data. Therefore, our data is not favor those who have access to the Internet, but our analysis is able to cover demand including those who are unfamiliar with the Internet.
5 Real prices of the used-cars were calculated based on the 'automobile' deflator of the fiscal 2015 Consumer Price index (CPI). (http://www.e-stat.go.jp/SG1/estat/List.do?bid=000001074278&cycode=0)
6 Other than body types showed in Table 2, there are several available body type data but we exclude them because their sample sizes were small.
7 For each body types, If the standard deviation of a control variable is 0, the control variables is excluded from the model (Table A2 in the Appendix).

and HB in the first half of May in 2011 were also under 50. Therefore the second half of April of all body types except MO and LR, and the first half of May of HB were excluded from our analysis.

Table 3. Correlation tables for independent variables in our model (the three years of data pooled for all body types)

	LnP	X1	X2	X3	X4	X5	X6	X7	X8	R
LnP	1									
X1	.011	1								
X2	.126	-.029	1							
X3	.165	.033	-.028	1						
X4	-.004	.002	-.003	-.002	1					
X5	-.005	-.004	-.005	-.004	.0	1				
X6	-.561	-.097	.154	-.112	.002	.003	1			
X7	-.281	-.021	.205	-.032	.002	-.007	.332	1		
X8	.387	.066	.335	.041	-.003	-.005	.163	.125	1	
R	-.150	.058	.101	-.046	-.001	-.006	.106	.177	-.117	1

5 Result

By applying equation (1) for each body type in each issue from January 2010 to March 2012, we observe how the estimated regional dummies (R_i) varied before and after the disaster. Table 4 summarizes estimated regional dummies for each body type in each issue before and after the disaster. In Table 4, if the lower 95% confidence limit of the estimated regional dummy is higher than the upper limit of the same dummy in corresponding period of 2010, '+' is plotted (For example, the lower 95% confidence limit of the first half of April is compared with the upper 95% confidence limit of the first half of the April in 2010). If the difference between the lower 95% confidence limit of the estimated regional dummy and the upper limit of the corresponding period of 2010 is positive (a cell shows '+'), we also estimated the effect sizes[8] of these regional dummies. If the effect size of a regional dummy is 0.02 or more, in the corresponding cell in Table 4 is shaded. For this study, we do not identify a regional dummy as having a significant effect if its effect size of the regional dummy is less than 0.02.

As shown in Table 4, There were statistically significant effects of regional dummies for LC, LT, and MO at some points after the disaster. Table A2 in the Appendix presents estimation results of LC, LT, and MO. Figure 1 to Figure 3 illustrates how the regional dummies of LC, LT, and MO changed before and after the disaster, and shows their effect size and adjusted R^2. In the three years (2010-2012) including the periods where there were no statistically significant effects of regional dummies, the lowest adjusted R^2 of LC, LT, and MO, are .62, .54, and .73 respectively. These high values of the adjusted R^2 suggest that applying the hedonic approach to these used-car types are proper[9]. We could have improved the model for each body type but, for the purpose of this study, we only focus on the variables of regional dummies (R_i) and did not add or exclude any variables.

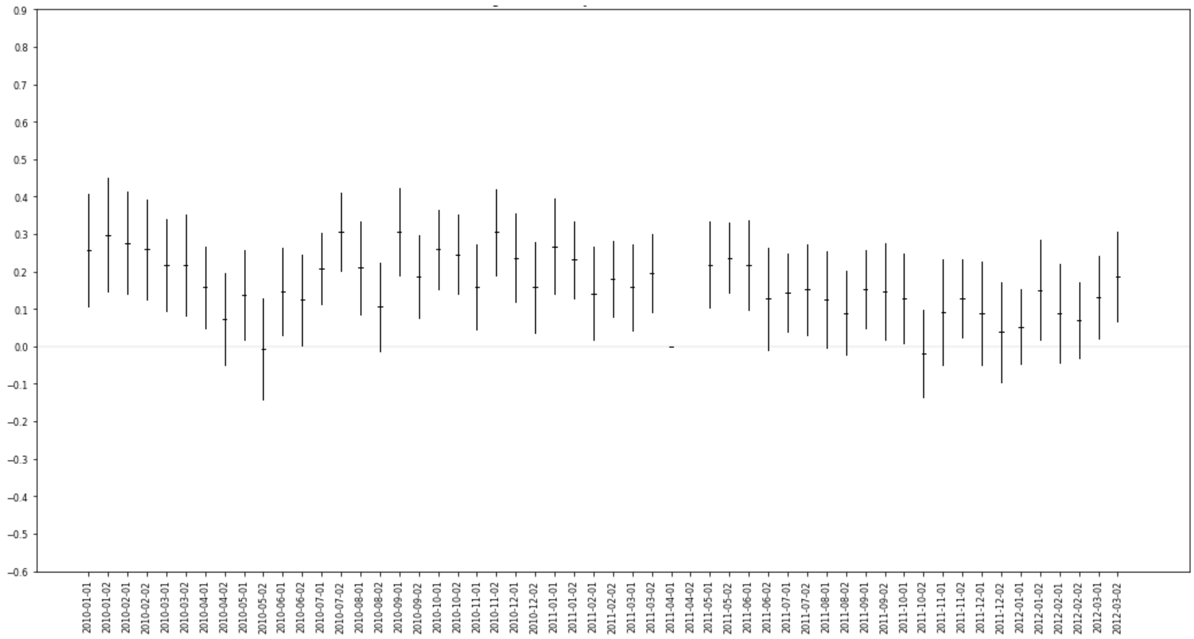
Table 4. Estimated regional dummy coefficients for each body type

	2011																	2012					
	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	1	1	2	2	3	3
	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
CV	/	/																					
CS	/																						
HB	/		+	+																			
HT	/																						
LA	/	+																					
LC	/		**+**																				
LR		+	+	+																			
LT	/					**+**	**+**																
MO	+					**+**				**+**	**+**												
SD	/																						
SU	/	+																					
TR	/																+						
WG	/																						

Note 1: The diagonal lines indicate its cell is excluded from our analysis because of small sample data size as described in Section 4.
Note 2: + shows that the lower limit of regional dummy 95 % confidence limit is higher than the lower limit of the corresponding period of 2010.
Note 3: A shaded cell means that Note 1 is '+' and an effect size of the regional dummy is 0.02 or more, or the effect size of the regional dummy of the corresponding period of 2010 is 0.02 or more.

8 We calculate effect size of regional dummies by Cohen's f. $Choen's\ f = \frac{((R\times1\times2)^2-(R\times1)^2)}{(1-(R\times1\times2)^2)}$ where $(R\times1\times2)^2$ is our model with all of the variables, and $(R\times1)^2$ is the model without the regional dummies.

9 Attributes of used-car buyers could be a different variable that explains each body types' prices but there is no such personal data to include in our model. However, the high value of the adjusted R^2 suggests that the variation in used-car prices can be explained well by our variables in the model.

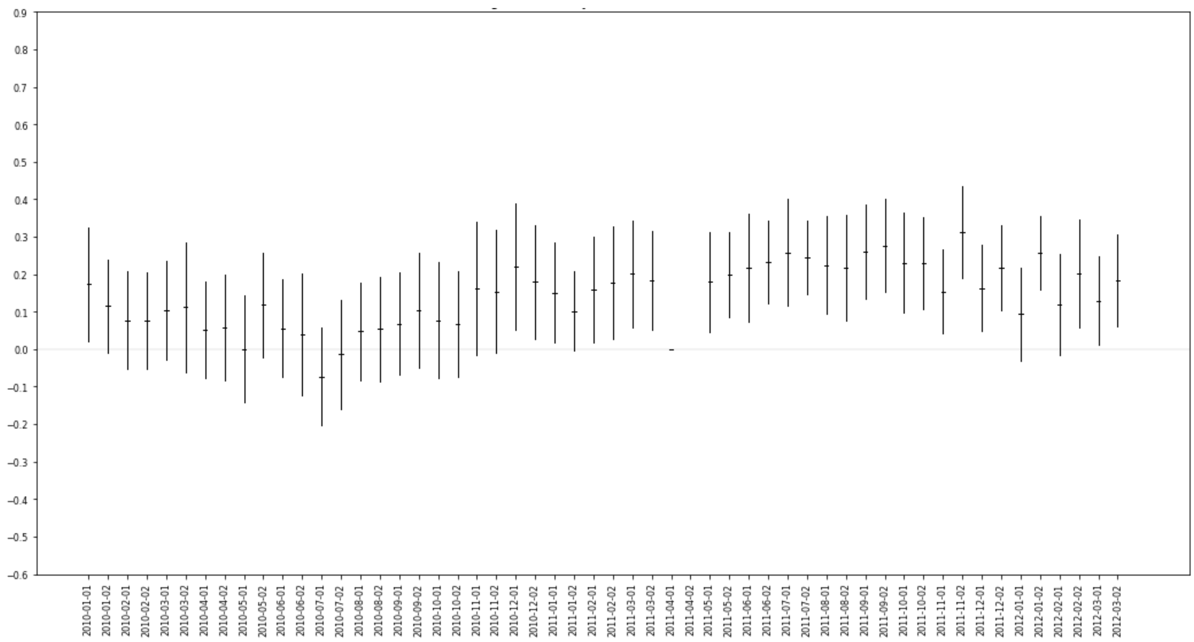


	2010																							
	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
D	+	+	+	+	+	+	+	0	+	0	+	+	+	+	+	0	+	+	+	+	0	+	+	+
d																								
E																								
r																								

	2011																								2012					
	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	1	1	2	2	3	3
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
D	+	+	+	+	+	+			+	+	+	0	+	+	0	0	0	+	0	0	0	+	0	0	0	+	0	0	+	+
d										+																				
E										.17																				
r										.79																				

D: The regional dummy's coefficient. + means a coefficient is significantly positive. – means a coefficient is significantly negative. 0 means a coefficient is not significant.
d: + shows that the lower limit of 95 % confidence interval of regional dummy is higher than the upper limit of the corresponding period of 2010.
E: the regional dummy's effect size. Shadowed cell means its d = + and E>0.02.
R: A regression model's adjusted R^2.

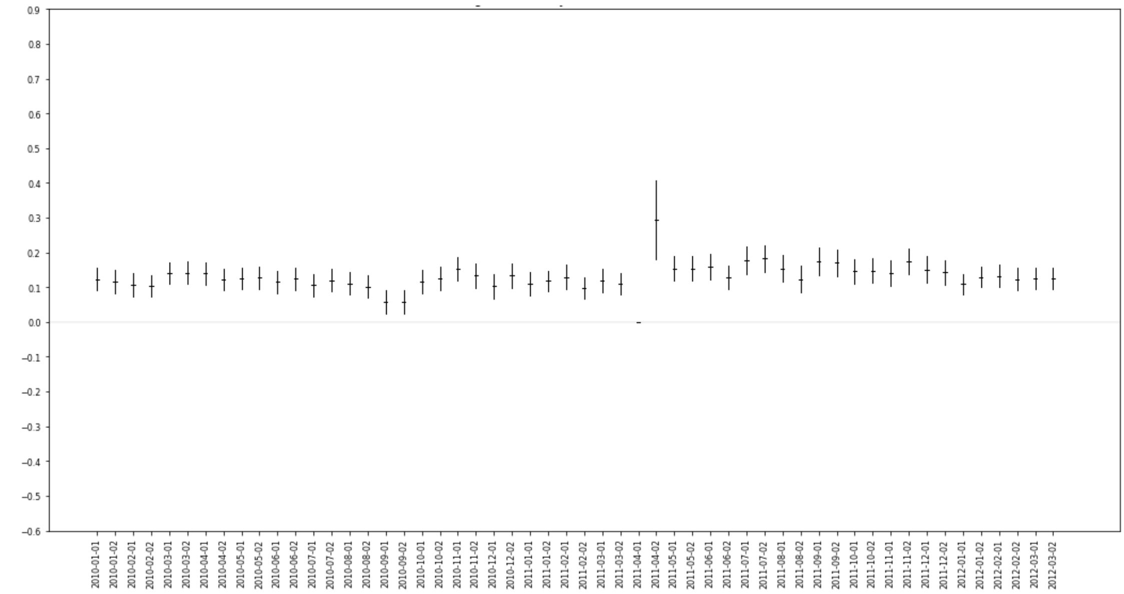
Figure 1. LC regional dummy 95% confidence intervals



	2010																							
	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
D	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+
d																								
E																								
r																								

	2011																								2012					
	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	1	1	2	2	3	3
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
D	+	0	+	0	+	+			+	+	0	+	+	+	+	+	+	+	+	+	+	+	+	+	0	+	0	+	+	+
d													+	+																
E													.09	.15																
r													.64	.74																

Figure 2. LT regional dummy 95% confidence intervals



	2010																							
	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
D	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
d																								
E																								
r																								

	2011																							
	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
D	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
d													+				+	+						
E													.04				.04	.04						
r													.76				.75	.76						

	2012					
	1	1	2	2	3	3
	1	2	1	2	1	2
D	+	+	+	+	+	+
d						
E						
r						

Figure 3. MO regional dummy 95% confidence intervals

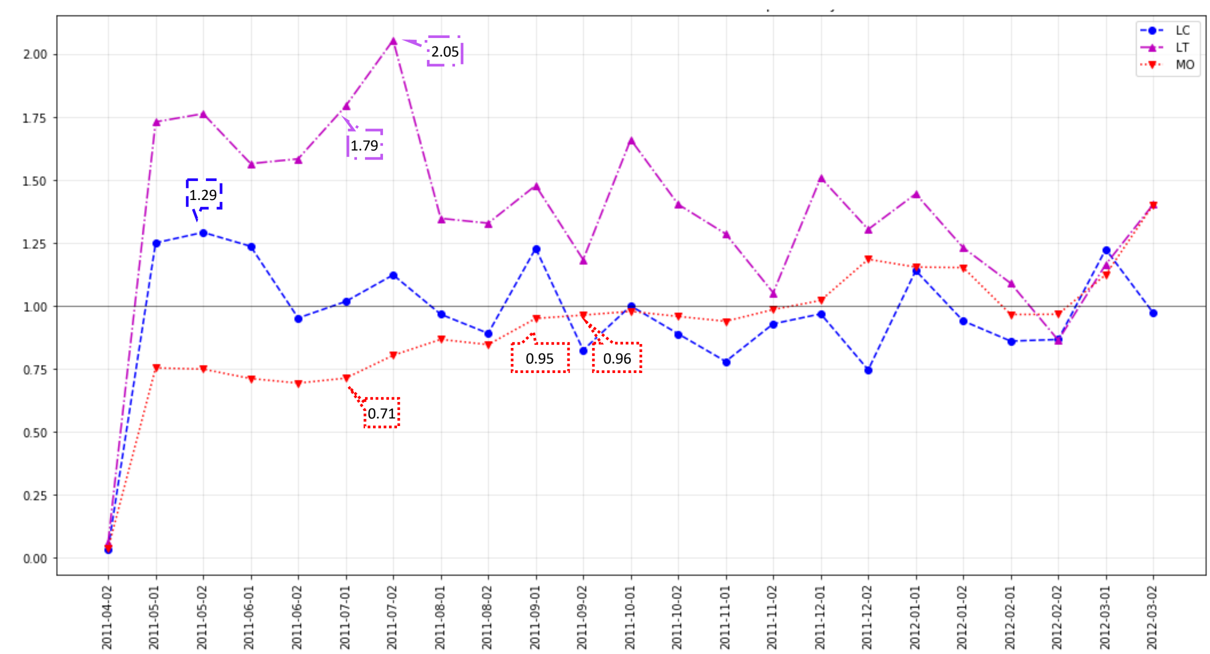
6 Discussion

In this section, we discuss the results of our model. The current analysis reveals that there were significant effects of the regional dummies for three body types, LC (in the second half of May), LT (in July), and MO (in the first half of July and September) after the disaster.

Figure 4 shows the amount of each body type in the disaster area over the corresponding period of the previous year. As shown in Figure 4, when there were significant effects of the regional dummies for LC and LT, the amounts of these body types were greater than those in the corresponding period of 2010. Therefore, although the supplies of these two body types might have increased in the damaged area, there was greater demand for LC and LT. However, when MO was most in demand in the disaster area, the amount of MO was below the amount in the corresponding period of the previous year. Therefore, it should be noted that the decreased MO's supply in the disaster area might have caused the increased price of MC in the area.

Next, we discuss our result in comparison to the previous study results (Shibuya & Tanaka, 2017). Our previous study analyzed used-car data between in the disaster area and Chugoku area, and found that there was the excess demand for LC, LT and LR in the disaster area. Both the current and previous studies reveal that LC and LR were in excess-demand after the disaster. On the other hand, excess demand for MO was not indicated in the previous study and excess demand for LR was not indicated in the current study. These different results might reflect whether the area compared to the disaster area is metropolitan or provincial. The comparison area's characteristics might have reflected the results of our model. Thus, our future study needs to look into other non-damaged areas' data in comparison to the disaster area.

Thirdly, our result might suggest that the time periods when used cars were most in demand might have depended on the price ranges of body types. As shown in Figure 4, relatively low-price body types such as LC were most in demand right after the disaster. On the contrary, relatively high-price body types such as MO gradually began to be in demand several months after the disaster. This might imply that people in the disaster area might have tended to seek less expensive body types in the aftermath of the disaster because of the property loss and anxiety about the future. When their lives became more stable they might have begun to buy relatively high-priced used cars.



Note: The number of used car over the corresponding period of 2010 is shown when there was the excess demand for the body type in the corresponding time period.

Figure 4. Number of used cars over the corresponding period of 2010 in the disaster area

7 Conclusion

This study aimed to deepen the understanding of the demand for used cars after the Great East Japan Earthquake and Tsunami. We compared used-car market data in the disaster-stricken area and Tokyo by applying the Hedonic Model. As a result, our analysis reveals that, in the disaster area, there was excess demand for Light Motor Vehicle Cab Vans (LC), Light Motor Vehicle Trucks (LT) and for Mini Vans and One Box cars (MO) after the disaster. As to LC and LT, the results correspond to our previous study (Shibuya & Tanaka, 2018), suggesting the robustness of the excess demand for LC and LT after the disaster in the disaster-stricken area. On the other hand, while the current study shows that there was the excess demand for MO in the disaster area compared to Tokyo, our previous study (Shibuya & Tanaka, 2017) shows that there was excess demand for LR instead. The comparison area might affect the result of our model differently. Further research regarding area differences is needed. In addition, the results suggest when and what kind of car features were sought in the disaster area. We found that, among those most in demand body types, people in the disaster-area might have bought cheaper body types right after the disaster. The more expensive body types, on the contrary, were most in demand about several months after the disaster.

Our analysis was able to contribute academically to deepening the understanding of used-car demand after the Great East Japan Earthquake and Tsunami of 2011 by showing which body types were most in demand and when those demands were higher. In addition, our result will be beneficial for further research regarding people's demand after a large-scale disaster. However, as mentioned above, the different results between the current study and our previous study imply that there is a need to study more about the characteristics of the comparison areas and expand the comparison to non-disaster areas. Also, the research regarding comparison of used-car and new-car market data would be another interesting study topic.

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APPENDIX

Table A1. Statistical Summary of our model (three-year pooled data)

Type		ln*P*	X_{1i}	X_{2i}	X_{3i}	X_{4i}	X_{5i}	X_{6i}	X_{7i}	X_{8i}	R_i
CV	mean	13.77	0.95	0.38	n.a.	0.00	0.00	6.74	0.32	2297	0.35
N=9,393	std	0.69	0.21	0.49	n.a.	0.01	0.04	3.32	0.47	471	0.48
	min	11.32	0.00	0.00	n.a.	0.00	0.00	0.00	0.00	1300	0.00
	max	15.39	1.00	1.00	n.a.	1.00	1.00	19.00	1.00	4300	1.00
CS	mean	13.74	0.77	0.00	0.02	0.00	n.a.	13.13	0.23	2232	0.39
N=12,014	std	0.85	0.42	0.01	0.13	0.01	n.a.	6.76	0.42	707	0.49
	min	10.33	0.00	0.00	0.00	0.00	n.a.	0.00	0.00	0	0.00
	max	16.93	1.00	1.00	1.00	1.00	n.a.	39.00	1.00	4000	1.00
HB	mean	13.27	0.99	0.00	0.00	0.00	0.00	5.72	0.05	1362	0.53
N=48,176	std	0.65	0.12	0.01	0.04	0.01	0.01	3.20	0.23	264	0.50
	min	10.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	660	0.00
	max	16.17	1.00	1.00	1.00	1.00	1.00	20.00	1.00	2500	1.00
HT	mean	13.13	0.94	0.00	n.a.	0.00	n.a.	10.85	0.20	2377	0.49
N=9,466	std	0.86	0.25	0.03	n.a.	0.01	n.a.	4.39	0.40	480	0.50
	min	9.83	0.00	0.00	n.a.	0.00	n.a.	1.00	0.00	1500	0.00
	max	15.44	1.00	1.00	n.a.	1.00	n.a.	30.00	1.00	4000	1.00
LA	mean	13.02	0.98	0.00	0.00	0.00	0.00	6.96	0.08	n.a.	0.63
N=22,668	std	0.69	0.13	0.02	0.02	0.02	0.02	4.53	0.28	n.a.	0.48
	min	10.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n.a.	0.00
	max	14.53	1.00	1.00	1.00	1.00	1.00	21.00	1.00	n.a.	1.00
LC	mean	13.02	0.25	n.a.	n.a.	0.00	0.01	6.51	0.21	n.a.	0.44
N=6,645	std	0.59	0.43	n.a.	n.a.	0.00	0.11	4.21	0.40	n.a.	0.50
	min	10.33	0.00	n.a.	n.a.	0.00	0.00	0.00	0.00	n.a.	0.00
	max	14.47	1.00	n.a.	n.a.	0.00	1.00	21.00	1.00	n.a.	1.00
LR	mean	13.20	1.00	0.00	0.00	0.00	0.00	6.72	0.12	n.a.	0.67
N=99,955	std	0.62	0.06	0.02	0.01	0.01	0.03	4.22	0.33	n.a.	0.47
	min	10.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n.a.	0.00
	max	15.92	1.00	1.00	1.00	1.00	1.00	22.00	1.00	n.a.	1.00
Type		lnP	X1i	X2i	X3i	X4i	X5i	X6i	X7i	n.a.	Ri
LT	mean	12.98	0.33	n.a.	n.a.	n.a.	n.a.	8.02	0.13	n.a.	0.63
N=6,072	std	0.59	0.47	n.a.	n.a.	n.a.	n.a.	5.24	0.34	n.a.	0.48
	min	10.62	0.00	n.a.	n.a.	n.a.	n.a.	0.00	0.00	n.a.	0.00
	max	14.87	1.00	n.a.	n.a.	n.a.	n.a.	22.00	1.00	n.a.	1.00
MO	mean	13.54	1.00	0.02	0.01	0.00	0.00	7.10	0.15	2107	0.53
N=135,014	std	0.81	0.01	0.13	0.11	0.02	0.01	3.29	0.36	538	0.50
	min	10.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1000	0.00
	max	16.26	1.00	1.00	1.00	1.00	1.00	20.00	1.00	3500	1.00
SD	mean	13.88	0.97	0.00	0.15	0.00	0.00	7.01	0.12	2564	0.40
N=48,196	std	0.87	0.16	0.03	0.36	0.01	0.02	4.29	0.32	954	0.49
	min	10.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1000	0.00
	max	16.55	1.00	1.00	1.00	1.00	1.00	26.00	1.00	5000	1.00
SU	mean	13.97	0.99	0.14	0.02	0.00	0.00	8.74	0.19	2741	0.51
N=30,922	std	0.72	0.08	0.35	0.15	0.01	0.01	5.39	0.40	879	0.50
	min	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1100	0.00
	max	16.12	1.00	1.00	1.00	1.00	1.00	27.00	1.00	4800	1.00
TR	mean	14.04	0.65	0.65	n.a.	n.a.	0.01	8.94	0.24	3397	0.46
N=8,264	std	0.59	0.48	0.48	n.a.	n.a.	0.08	4.38	0.43	1439	0.50
	min	11.94	0.00	0.00	n.a.	n.a.	0.00	0.00	0.00	1200	0.00
	max	15.46	1.00	1.00	n.a.	n.a.	1.00	28.00	1.00	9200	1.00
WG	mean	13.23	0.99	0.00	0.00	0.00	0.00	7.93	0.14	1995	0.49
N=23,026	std	0.85	0.09	0.04	0.01	0.01	0.01	3.53	0.35	369	0.50
	min	9.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1000	0.00
	max	15.39	1.00	1.00	1.00	1.00	1.00	23.00	1.00	3500	1.00

Table A2 Estimation Result (CB in the second half of April 2011, LC in the second half of April and May 2011, LT in July 2011, and MO in the first half of July and in September)

LC

Issue		intercept	X_{1i}	X_{2i}	X_{3i}	X_{4i}	X_{5i}	X_{6i}	X_{7i}	X_{8i}	R_i
2011/5 2ND	coef.	13.67***	0.03	n.a.	n.a.	0.00***	-0.09	-0.10***	-0.51***	n.a.	0.24***
Adj.R^2=.79	s.e.	0.05	0.05	n.a.	n.a.	0.00	0.19	0.01	0.06	n.a.	0.05

LT

Issue		intercept	X_{1i}	X_{2i}	X_{3i}	X_{4i}	X_{5i}	X_{6i}	X_{7i}	X_{8i}	R_i
2011/7 1ST	coef.	13.56***	0.07	n.a.	n.a.	n.a.	n.a.	-0.08***	-0.54***	n.a.	0.26***
Adj.R^2=.64	s.e.	0.08	0.07	n.a.	n.a.	n.a.	n.a.	0.01	0.10	n.a.	0.07
2011/7 2ND	coef.	0.00***	0.02	n.a.	n.a.	n.a.	n.a.	-0.09***	-0.30***	n.a.	0.24***
Adj.R^2=.74	s.e.	0.00	0.05	n.a.	n.a.	n.a.	n.a.	0.00	0.08	n.a.	0.05

MO

Issue		intercept	X_{1i}	X_{2i}	X_{3i}	X_{4i}	X_{5i}	X_{6i}	X_{7i}	X_{8i}	R_i
2012/7 1ST	coef.	7.04***	7.04***	0.66***	0.00***	0.00***	0.00***	-0.19***	-0.32***	0.00***	0.18***
Adj.R^2=.76	s.e.	0.02	0.02	0.11	0.00	0.00	0.00	0.00	0.03	0.00	0.02
2011/9 1ST	coef.	7.03***	7.03***	0.51***	0.25	0.00***	0.00***	-0.19***	-0.30***	0.00***	0.17***
Adj.R^2=.75	s.e.	0.02	0.02	0.08	0.17	0.00	0.00	0.00	0.03	0.00	0.02
2011/9 2ST	coef.	7.01***	7.01***	0.55***	0.28*	0.00***	0.00***	-0.18***	-0.34***	0.00***	0.17***
Adj.R^2=.76	s.e.	0.02	0.02	0.08	0.15	0.00	0.00	0.00	0.02	0.00***	0.02