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Evaluation of Professional Quality Reports for U. S. Automotive Market between 2001 and 2012

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ABSTRACT

Before purchasing a car, consumers review the information on the quality, reliability, safety and customer satisfaction to minimize their risk of purchasing a car with defects. Two major sources of such information are Consumer Reports and surveys by J. D. Power and Associates: Initial Quality Survey and Vehicle Dependability Study). These reports have established a reputation for their independence, reliability and unbiased opinions. The purpose of this paper is to determine whether consumers rely on these reports in purchasing a new car, and if this is the case, which report has more impact on consumer purchasing behavior. The impact of these reports on the market share of the foreign and domestic automobile manufacturers in the U. S. market between 2001 and 2012 was analyzed using the event study methodology.

Keywords: automobile, consumer reports, initial quality reports, reliability, quality, vehicle dependability study, safety

INTRODUCTION

Automobile surveys provide the consumer with valuable information before purchasing a car. Two major, unbiased sources of automobile information are *Consumer Reports* (CR) and the J. D. Power and Associates' (JDP) surveys. Since 1936, *Consumer Reports* has been published by Consumers Union, an independent, nonprofit organization that does not accept advertising to maintain its impartiality in evaluating products (Senoz, Daughton, Gosavi & Cudney, 2011). JDP, founded in 1968, is a global market research company that provides information on automobile quality, reliability, safety, buyer behavior and customer satisfaction. The company generates its income from selling the survey data to other companies and the endorsement value of its awards. JDP maintains its surveys reflect the opinions of consumers only, and in order to stay impartial and deliver unbiased results, JDP funds all of its syndicated research (Senoz et al., 2011). The JDP's *Initial Quality Study* (IQS) provides feedback on defects that are experienced

within the first 90 days of new car ownership. Using the IQS data, awards for the three best vehicles in different car categories are generated. These awards are used extensively in advertising to influence the purchasing decisions made by consumers (Shin, Richardson, & Soluade, 2013). JDP also issues the *Vehicle Dependability Study* (VDS). In the VDS, owners of three-year-old vehicles that were purchased new are surveyed to identify defects within the past twelve months.

Before purchasing a car, consumers review the information on the quality, reliability, safety and customer satisfaction to minimize their risk of purchasing a car with problems. Such information reduces the risk of making a decision with partial or imperfect information (Heizer & Render, 2012). This paper evaluates the quality measurements of JDP and CR and their economic impact on the sales performance in the United States from 2002 to 2012. The following automobile manufacturers were included in the study: GM, Ford, Chrysler, Toyota, Honda, Nissan, Mercedes, BMW, Volkswagen, Kia and Hyundai. The research addresses the following issues: (1) sales impact on customers' purchasing behavior during the study period by JDP and CR, and (2) benefits generated from CR and JDP reports by country of origin (United States, Japan, Germany or Korea).

These research issues are addressed utilizing the event study methodology of Bowman (1983) and De Jong (2007). Event study is a statistical technique developed for financial research to find the stock market reaction to important financial events. For example, mergers and acquisitions, earnings announcements, corporate reorganizations, and investment decisions were analyzed (McWilliams & Siegel, 1997; Winkler, 2014). The impact on an individual firm or group of companies was measured by national sales and market share.

In a prior study, Shin et al. (2013) estimated the impact of quality measurements from IQS on the sales performance of major American and Japanese automakers from 2001 to 2010. The study concluded that IQS was used as a major information source in making a decision to minimize the consumer's risk when purchasing a car. However, the study was limited to the ten years ending in 2010, and IQS's impact on sales of German and Korean automakers was not analyzed. Furthermore, the study did not evaluate the impact of VDS and CR, major sources of information considered in determining consumers purchasing behavior. This research extends the study period to twelve years ending with 2012 and includes the impacts of VDS and IQS by JDP and CR reviews.

The next section addresses the application of the event study methodology and background information derived from J. D. Power's IQS and VDS, and CR' surveys. The case study section presents event study results from IQS, VDS and CR survey analyses. Finally, the conclusion section reviews the application of the model and limitations and extensions of the model for future research.

BACKGROUND

Event study (Bowman, 1983; De Jong, 2007) measures valuation effects of a corporate event by examining market responses following an event. In this paper, event study is adapted to measure

the impact of the quality (i.e., VDS, IQS and CR) on the manufacturer's sales performance. Figure 1 illustrates the event study that measures the effect by comparing the market responses before and after the event. Before an event, the model assumes there is a constant level of sales that is called *basis* or *normal return*. The *mean-adjusted return model* (De Jong, 2007) was adapted to define the basis as the average of the market shares during an estimation period prior to the event date. After basis is estimated, sales loss or gain, called as *abnormal return*, is estimated as the difference between the basis and the return after the event until the effect of the event diminishes to the basis (i.e., point *P* in Figure 1). *Event window* is the time horizon between the event date and the date the event diminishes, i.e., time horizon between *T* and *S*. In Figure 1, the shaded area enclosed by the basis and the market share during the *event window* (*T* and *P*) illustrates the cumulated effect of the event. This is called *cumulative abnormal return* (CAR). The average of CARs of all the companies is called as *cumulative average abnormal returns* (CAAR). Then, the event study model tests if the event had an influence on the automaker's sales performance during the event window. The most commonly used test for such scenario is t-test (De Jong, 2007). For more extensive information on event study, please refer to Shin et al. (2013) and De Jong (2007).

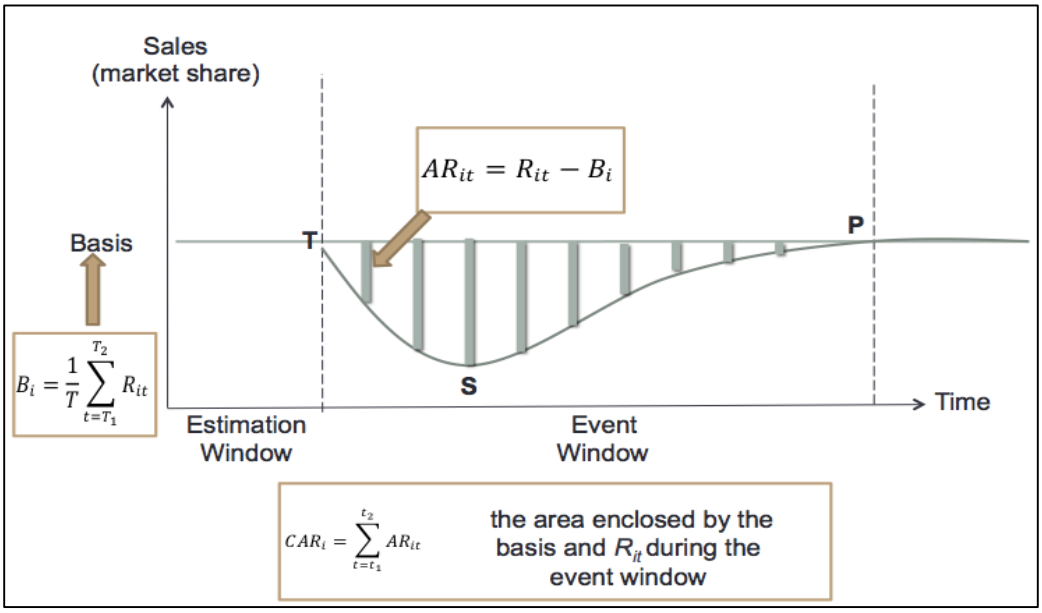


Figure 1: Illustration of Event Study.

Automobile Quality Information Reports

In the United States, CR, VDS and IQS are three major sources of information on automobile reliability, quality and safety; but there are some differences in publication schedule, data collection and data presentations of quality, reliability and safety.

Publication Schedule: CR is published monthly, and each year's April issue is a special edition that includes automobile quality information. Initial Quality Study by JDP is published in June of each year, while the Vehicle Dependability Study is available in April.

***Data Collection*:** CR ranks cars using two methods: annual surveys of consumers and its own tests that are conducted on their test track. CR's data are collected from annual surveys of about 7 million subscribers. After the survey results are tabulated, engineers test vehicles on the Consumer Reports' test track to check against the survey data results (Winkler, 2014). JDP also collects data from surveys, and there are two reports published by JDP: *Initial Quality Study* (IQS) and *Vehicle Dependability Study* (VDS). IQS provides feedback on quality of new vehicles during the first 90 days of ownership such as mechanical quality indicators, i.e., defects and malfunctions, and design quality indicators, i.e., user-friendliness of a feature (J. D. Power, 2014a). In VDS, CR measures problems experienced during the past 12 months by original owners of three-year-old vehicles, and includes symptoms across all areas (J. D. Power, 2014b).

Quality Presentation: Both CR and JDP evaluate quality of automobiles by gathering information through surveys, while only the CR staff conducts actual road tests. CR buys and tests cars each year and drives them for thousands of miles to evaluate quality. After road tests, CR provides summary information on quality including recommended vehicles. In order to be listed as a CR recommendation, a model is required to meet three criteria. First, the model must to do well on road tests. Second, the model must have at least average predicted reliability. Finally, if the model was crash-tested by the National Highway Traffic Safety Administration (NHTSA) or the Insurance Institute for Highway Safety (IIHS), it must have performed at least adequately (Senoz et al., 2011). JDP publishes IQS to provide feedback on quality of new vehicles during the first 90 days of ownership. Since IQS only covers the first three months of ownership, it is criticized, because three months is too short a time for automobiles to reveal defects. In addition, IQS has issues with the small samples for popular models and policies such as placing equal numerical weight on blown engines as for vibrating ashtrays (Snyder, 2009).

Reliability Presentation: CR provides a *Reliability History Chart* for evaluating reliability (Consumer Reports, 2012). The chart shows whether a particular model has had more or fewer problems than the average during that year. This spans ten years for major parts such as engine, cooling, transmission, drive system, fuel system, electrical, suspension, brakes, etc. (Senoz et al., 2011). Also, it includes the predicted reliability rating for new car models based on a measure of how well a new model is likely to hold up based on the model's recent history, provided the model has not been significantly redesigned for the current model year (Senoz et al., 2011). For the same purpose, JDP publishes the VDS, which is based on survey data in nearly 200 problem areas (J. D. Power, 2014b). Original vehicle owners were asked to report the type and number of problems experienced during the preceding 12 months with their three-year-old vehicle (Senoz et al., 2011). There are four major areas: overall dependability, powertrain dependability, body and interior dependability, and feature and accessory dependability (J. D. Power, 2014b). The main difference between CR and JDP is that CR's reliability ratings are grouped into 17 major possible problem areas, and consumers are evaluating each individual item. For example, instead of one rating for "powertrain dependability," CR rates five areas related to powertrain: engine, transmission, brakes, drive system, and suspension, and for "body and interior dependability" rating, CR provides ratings for body integrity and paint/trim/rust (Senoz et al., 2011).

***Safety Presentation*:** CR provides crash and rollover tests results from two independent crash tests: the National Highway Traffic Safety Administration (NHTSA) and the Insurance Institute for Highway Safety (IIHS). These two organizations conduct crash tests using their own

methodologies. NHTSA scores its tests using a scale of one to five stars; the more stars, the safer the car. The IIHS uses a four-level scale: Poor, Marginal, Acceptable and Good (Senoz et al., 2011). JDP provides safety ratings for only the vehicles that were chosen for Power Steering Reviews (PSR). For a vehicle to make the PSR, it has to rank among the top three vehicles in its class in one of the ratings studies, has to have done well in the government crash tests and has to rank at the top in the fuel economy ratings by the EPA (Senoz et al., 2011).

CASE STUDY

Sales data were obtained from Automotive News Data Center (2013) that contained automakers' monthly sales in the United States between January 2001 and December 2012. Events are defined as the announcement of CR's annual auto issue (published in April between 2001 and 2012), JDP's IQS report (published each June between 2001 and 2012), and VDS report (published each February between 2001 and 2012). The estimation period is defined as one year; this is common in the current literature (Shin et al., 2013). The impact on sales performance was tested for one-month and two-month event periods after announcement of the IQS, VDS and CR results. The event study technique cannot evaluate the net effect of simultaneously occurring events (Bowman, 1983; De Jong, 2007). Therefore, the event window is limited to be no more than two months, since the annual announcements are published in February, April and June.

Event Study Results on CR

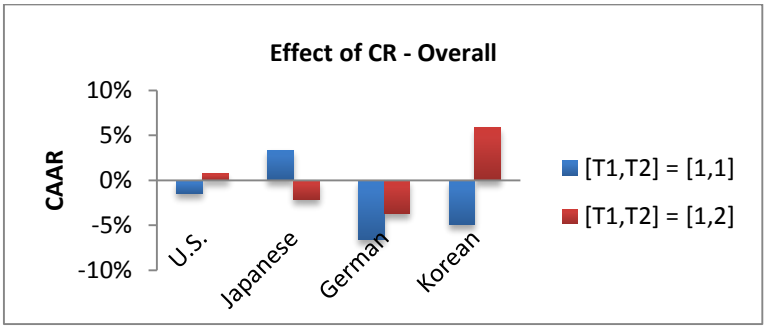
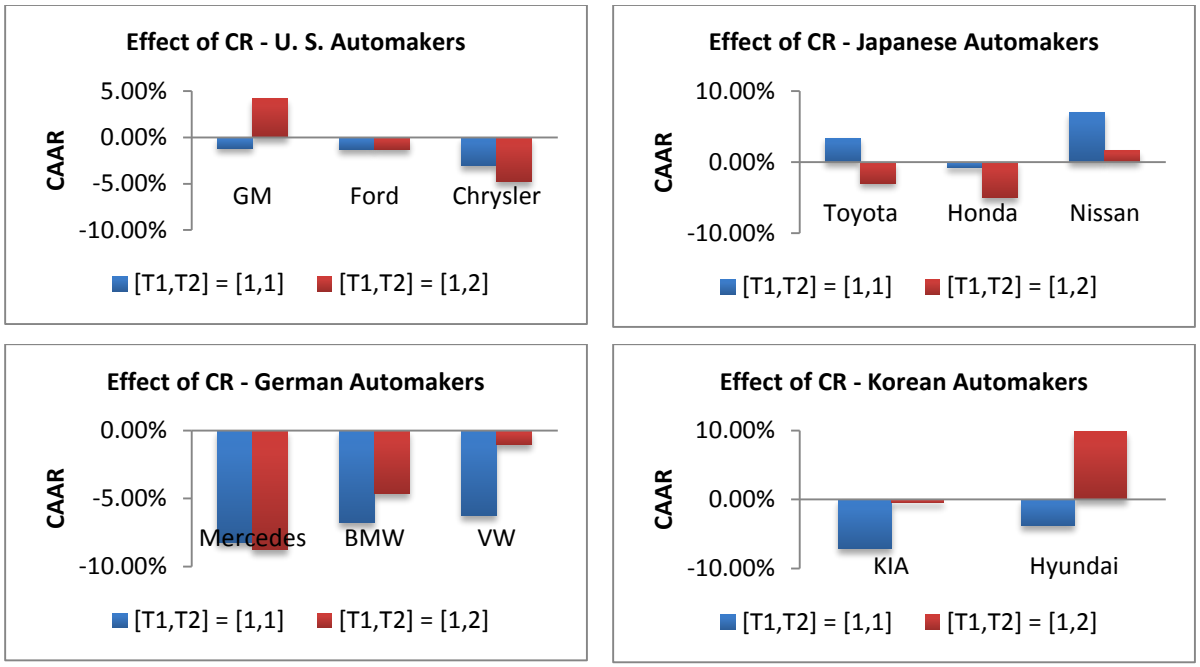


Figure 2: Effect of CR - Overall

Figure 2 displays the impact of CR on sales performance of automakers grouped by nation in the U. S. automobile market. For the first month after the announcement by CR, the U. S., German and Korean automakers lost market share (1.5 percent, 6.6 percent, and 4.9 percent, respectively). However, market share of Japanese automakers increased by 3.4 percent after the announcement. The impact on the automakers diminishes for the second months after the announcement. Figure 3 displays company CAAR after the announcement of CR. Nissan benefitted most from the CR with a market share increase of 7 percent in the first month after the announcement of CR, but the effect diminishes to 1.18 percent increase for the second month. Toyota also has positive market responses in the first month. Market shares of German automakers, i.e., Mercedes, BMW and VW, were initially reduced by -8.2 percent, -6.7 percent, and -6.2 percent respectively. However, negative impacts diminished significantly after two months.



*At 1% significance level CAARs of VW and Kia are not statistically significant for [T_1, T_2] = [1,2].

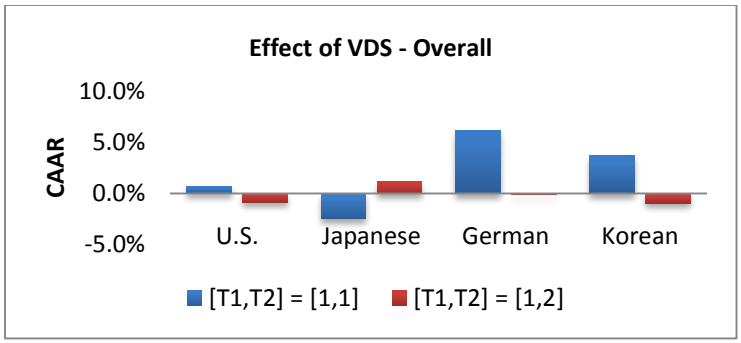
Figure 3: CAAR of CR for Each Automaker*.

Event Study Results on VDS by JDP

Results of the normal return calculation for VDS are listed in Table 1. Figure 4 displays the impact of VDS on sales performance of the U. S. automobile market. U. S., German and Korean automakers gained market share (0.7 percent, 6.1 percent, and 3.1 percent, respectively) for the first month after the announcement of VDS to the public, while Japanese automakers have negative market shares due to VDS of -2.4 percent after the announcement. Two months after the announcement, the effects of the VDS diminished for all except the Japanese automakers.

VDS	U. S. (%)			Japanese (%)			German (%)			Korean (%)	
Year	GM	Ford	Chrysler	Toyota	Honda	Nissan	Mercedes	BMW	VW	KIA	Hyundai
'01	0.41	-0.28	-0.75	0.04	1.72	0.27	0.70	2.33	-0.48	4.50	4.27
'02	-0.48	-0.36	-0.68	1.24	0.67	-2.33	2.50	3.24	1.67	3.42	2.77
'03	0.97	0.59	-0.71	0.14	1.02	2.74	1.29	2.67	-0.88	3.32	1.18
'04	0.07	-0.54	1.18	1.77	0.05	6.92	-0.06	-1.30	-1.21	-0.39	-1.03
'05	0.47	-0.56	0.79	1.80	0.04	1.59	-0.40	2.69	1.10	1.88	1.46
'06	0.63	-0.19	-0.02	0.79	1.58	-0.35	1.84	1.16	1.81	0.65	0.97
'07	-0.88	-1.12	0.84	1.28	1.02	1.51	3.63	0.71	1.03	2.47	-0.08
'08	0.81	0.19	-0.34	0.28	0.30	0.37	1.36	-0.86	0.05	0.40	-0.29
'09	-0.40	-0.18	-2.26	1.16	1.40	2.43	0.18	4.52	2.62	7.81	8.90
'10	0.77	1.59	-0.35	-1.48	-0.40	1.78	4.67	0.66	2.98	0.85	2.18
'11	-0.16	-0.32	3.74	2.85	0.73	-1.38	0.03	0.42	-0.57	0.86	0.52
'12	4.87	-1.22	0.95	-0.69	0.33	0.99	5.11	4.14	5.43	4.03	6.04

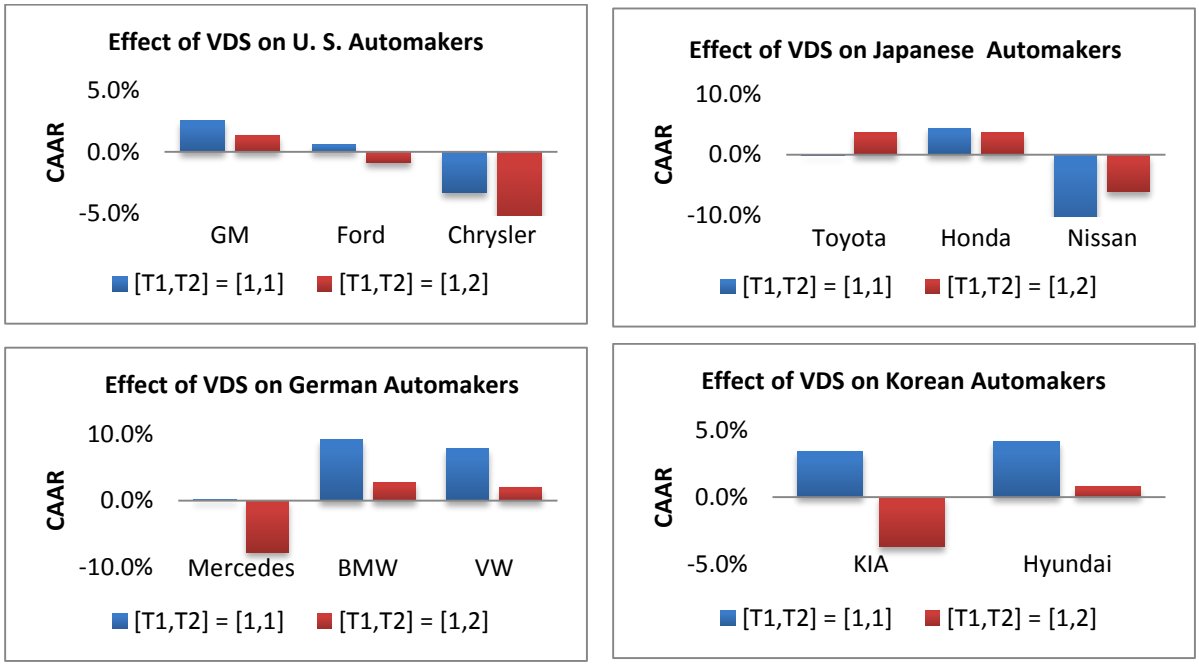
Table 1: Normal Returns Percentages for VDS.



*At 1% significance level, CAARs of German and Korean automakers is not statistically significant for [T_1, T_2] = [1,2].

Figure 4: CAAR of VDS by JDP*.

Figure 5 displays company CAAR after the announcement of VDS. German automakers, especially BMW and Volkswagen, attained the most benefit from the VDS with market share increased by 9.1 percent and 7.8 percent respectively after the announcement of CR. GM, Ford, Honda, Hyundai and Kia had a positive market response. The market shares of Chrysler and Nissan were significantly reduced to -3.3 percent and -13.3 percent respectively.



* At 1% significance level CAARs of Toyota and Mercedes are not statistically significant for [T_1, T_2] = [1,1], and CAAR of Hyundai is not statistically significant for both [T_1, T_2] = [1,1] and [T_1, T_2] = [1,2].

Figure 5: CAAR of VDS for Each Automaker*

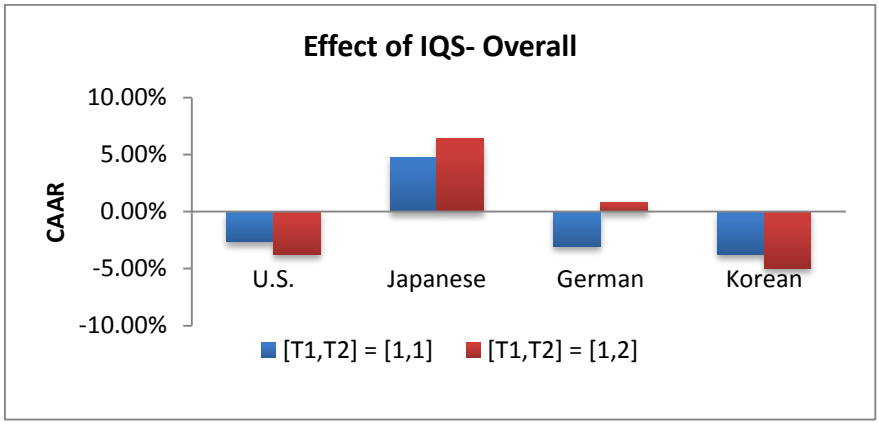
Event Study Results on IQS by JDP

The result of the normal return calculation for IQS is listed in Table 2. Figure 6 displays the impact of IQS published by JDP on the sales performance in the U. S. automobile market.

Except for the Japanese automakers (4.77 percent increase in market share for the first month), IQS had a negative impact on U. S. automakers (-2.62 percent on the first month and -3.72 percent on the second month after the IQS announcement). German automakers had a -3.02 percent decrease in the first month with a recovery in the second month after the IQS announcement, and Korean automakers decreased of 3.72 percent and 4.96 percent respectively for the first and the second months after the IQS announcement. Figure 7 displays an individual company's CAAR after the announcement of IQS. Market shares of Japanese automakers such as Toyota, Honda and Nissan increased significantly in sales, but Chrysler, BMW, and Kia lost significant market share after the announcement of IQS.

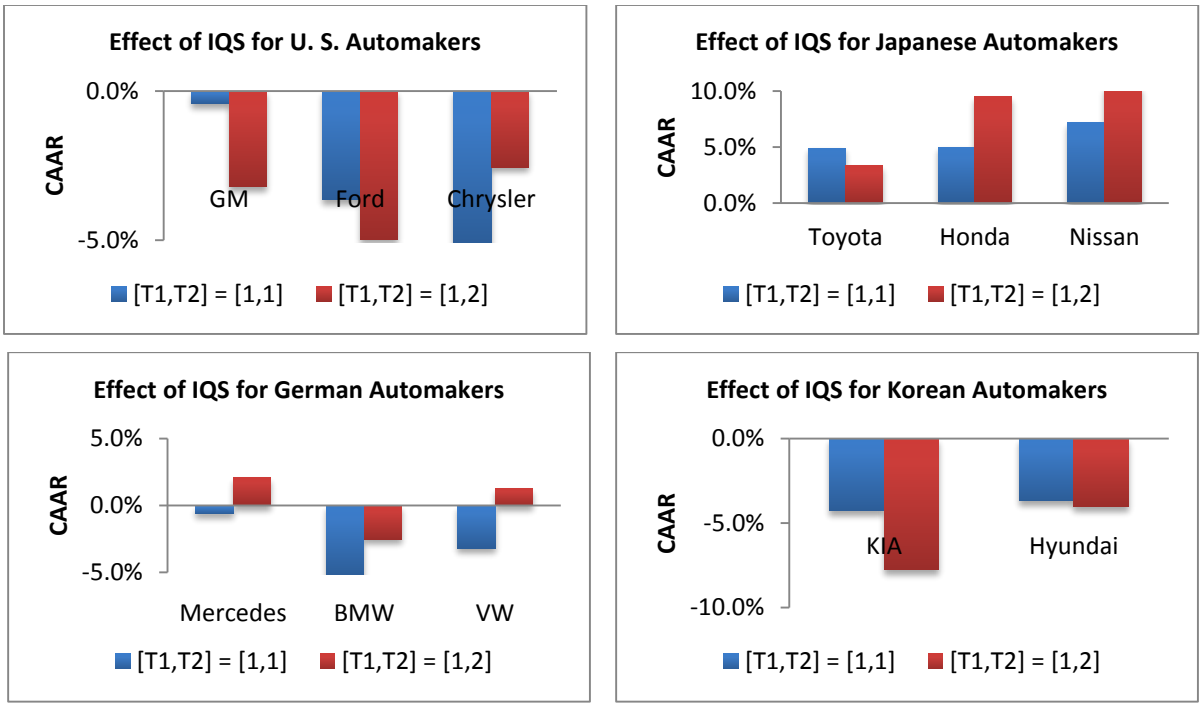
IQS	U. S. (%)			Japanese (%)			German (%)			Korean (%)	
Year	GM	Ford	Chrysler	Toyota	Honda	Nissan	Mercedes	BMW	VW	Kia	Hyundai
'01	0.37	-0.73	-0.37	1.19	0.80	-0.15	2.17	4.15	0.83	4.21	3.24
'02	-0.19	-0.39	0.38	0.95	0.51	3.08	0.81	2.97	0.99	1.92	1.97
'03	1.10	-0.35	-0.04	0.87	1.64	1.39	0.77	0.96	-1.00	1.62	1.18
'04	0.11	-0.36	0.07	0.82	0.83	2.29	-0.18	1.06	0.94	1.45	0.77
'05	0.19	-0.16	0.78	2.12	-0.20	1.67	1.46	0.93	-2.37	2.06	0.97
'06	-0.33	0.15	-0.68	1.69	1.90	-0.26	4.05	1.51	2.78	1.22	0.74
'07	0.64	-0.75	0.35	0.85	0.18	1.00	0.19	0.51	0.67	0.46	0.16
'08	-1.51	-0.34	-1.16	0.68	2.33	2.20	1.27	2.49	1.01	2.46	5.61
'09	1.94	1.39	-0.88	-0.44	-0.61	1.76	1.71	2.32	2.64	5.34	2.90
'10	0.04	0.45	1.83	0.02	0.43	1.29	2.25	-1.17	0.95	1.40	1.55
'11	0.66	0.29	-0.45	0.60	1.08	0.04	5.24	5.48	5.36	6.87	4.64
'12	1.84	0.85	1.81	1.67	-0.42	2.21	4.34	5.41	4.93	3.59	6.72

Table 2: Normal Returns Percentages for IQS.



*At 1% significance level, CAAR of German automakers is not statistically significant for [T_1, T_2] = [1,2].

Figure 6: CAAR of IQS by JDP*



*At 1% significance level, CAARs of BMW and Mercedes are not statistically significant for [T_1, T_2] = [1,1], and CAAR of VW is not statistically significant for [T_1, T_2] = [1,2].

Figure 7: CAAR of IQS for Each Automaker*.

Comparison of CR, VDS and IQS

Figure 8 illustrates the results of CAARs of the automobile makers grouped by county for [T_1, T_2] = [1, 1] caused by IQS, VDS, and CR. For the first month after the IQS, VDS and CR announcements, IQS and CR show similar effects on the automakers' sales performance, while VDS has the opposite effect on the sales. VDS has a positive effect on the sales of U. S., German and Korean automakers, but a negative effect on the sales of Japanese automakers. However, IQS and CR have a negative effect on the sales of U. S., German and Korean automakers. An interesting result is that a Japanese automaker, Toyota, had positive market responses from IQS, VDS and CR. The other automakers had a mixed response from these reports.

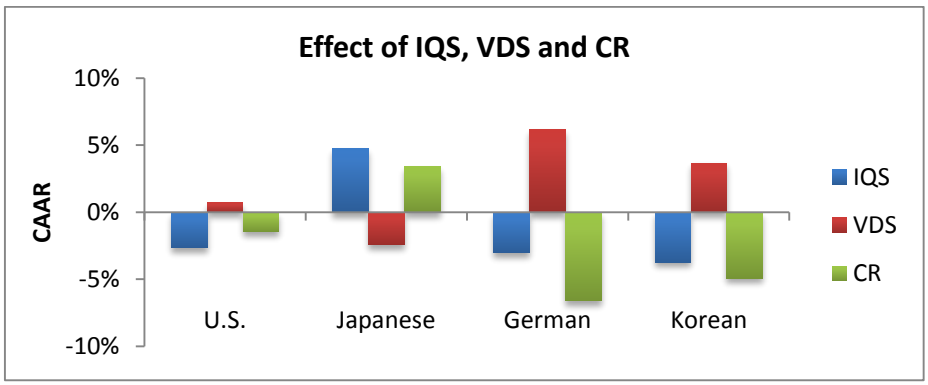


Figure 8: CAARs of CR, IQS, VDS for [T_1, T_2] = [1, 1].

CONCLUSION

U. S., German and Korean automakers lost market share for the first month after the announcement of CR to the public. This impact is reduced in subsequent months. This is also true of German automakers, whose market share dipped significantly after the first month of the CR announcement. The results of the Vehicle Dependability Study indicate that there was a gain in the market share for US, German, and Korean automakers, while it was not true for Japanese automakers. For all the automakers (both domestic and foreign), the impact of VDS diminished somewhat in subsequent months. German automakers benefited most from the Vehicle Dependability Study. The consumer reaction of German automakers to the IQS announcement was positive, whereas that of Chrysler, BMW and Kia lost significant market share after the IQS announcement. Overall, the event study accentuated the significance of the reports from J.D. Power & Associates, and Consumer Reports on the fluctuations in market share after the results of a study are announced.

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