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Are Larger Recalls More Damaging For Shareholders? Evidence From U.s. Automotive Recalls, 2005-2014

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ARE LARGER RECALLS MORE DAMAGING FOR SHAREHOLDERS? EVIDENCE FROM U.S. AUTOMOTIVE RECALLS, 2005-2014

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This thesis, submitted by Christopher J. Crow in partial fulfillment of the requirements for the Degree of Master of Science in Applied Economics from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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ABSTRACT

Motor vehicle recalls occur frequently in the United States. The number of motor vehicles being recalled has been increasing substantially over time. This paper examines whether the number of vehicles recalled per month has an effect on the shareholder's monthly abnormal return. Monthly abnormal return is the return which cannot be explained by the overall movement of the market. Five major auto manufacturers are included in this analysis with data ranging from April 2005 to December 2014. Two techniques are used in this paper; first, I use a series of ordinary least squares models followed by a series of mean comparison t-tests. Overall, the results indicate that the number of vehicles recalled per month provides little explanatory power of monthly abnormal returns. The one exception is Ford, from which the OLS results indicate that a 10 percent increase in the amount of vehicles recalled (initiated by the manufacturer) result in a 7.8 percent decrease in abnormal return. However, this result became weaker in significance and magnitude with the addition of control variables. The majority of the results indicate that the number of recalled vehicles does not affect shareholder's monthly abnormal return. It is likely that other attributes are more important and this suggests that direct costs of recalls are minimal. The results support the previous literature of Rupp (2003), who found the number of vehicles recalled had an insignificant effect on abnormal return using data from 1973-1998.

CHAPTER I

INTRODUCTION

With several recalls typically announced each month, motor vehicle recalls occur frequently in the United States. These recalls are carried out to correct defective vehicles. A single recall campaign can affect less than a hundred vehicles or tens of millions of vehicles. Recall campaigns are not always severe or safety-related. The direct and indirect costs to the manufacturer vary significantly between campaigns. The number of vehicles being recalled has been substantially increasing since the 1960's, especially in recent years.

Rupp (2003) found that the number of vehicles recalled provided little explanatory power for abnormal returns to shareholders using data from 1973-1998. The motivation behind this paper is due to the large increases in the size and number of recalls over the past ten years. This paper looks to readdress Rupp's findings using more recent data and a different technique. Rather than using a two- or three-day window surrounding individual recall announcements, as the majority of previous literature has done, this paper will use aggregated monthly data. Due to the large amount of recall campaigns and difficulty determining when investors first learned of a recall, this paper will attempt to capture a relationship between the number of vehicles recalled per month and monthly abnormal return for five manufacturers. These manufactures include Honda, Ford, GM, Toyota and Nissan.

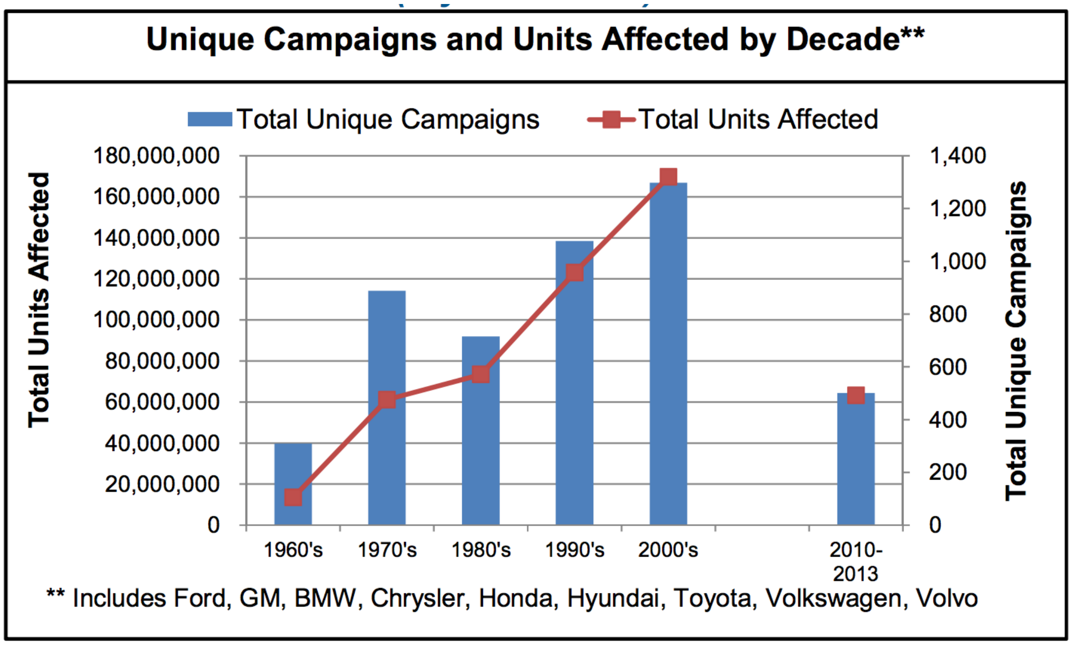
To accomplish this, two techniques will be used. First, a series of ordinary least squares regressions will be estimated between abnormal return and the number of vehicles recalled. Second, a series of mean comparison t-tests will be conducted to estimate differences in mean abnormal returns between designated groups. First I will address the latest trends in automobile recalls followed by previous literature on the topic. Then I will discuss the data and methodology used in the analysis. Lastly, I will conclude with some results and interpretations.

CHAPTER II

BACKGROUND

In 2014, over 60 million vehicles were recalled in the United States, breaking the record of 30.8 million vehicles in 2004, according to data from the National Highway Traffic Safety Administration (NHTSA). General Motors recalled over 28 million vehicles in 2014, setting a new record for any single auto manufacturer. The number of vehicles being recalled in the United States has been increasing since the NHTSA first started instituting them in the 1960's. Also increasing is the average number of vehicles affected per recall. Figure 1 below displays both the increases in recall campaigns as well as increases in the average number of units affected by decade for nine of the largest manufacturers.

Figure 1: Unique Campaigns and Units Affected by Decade



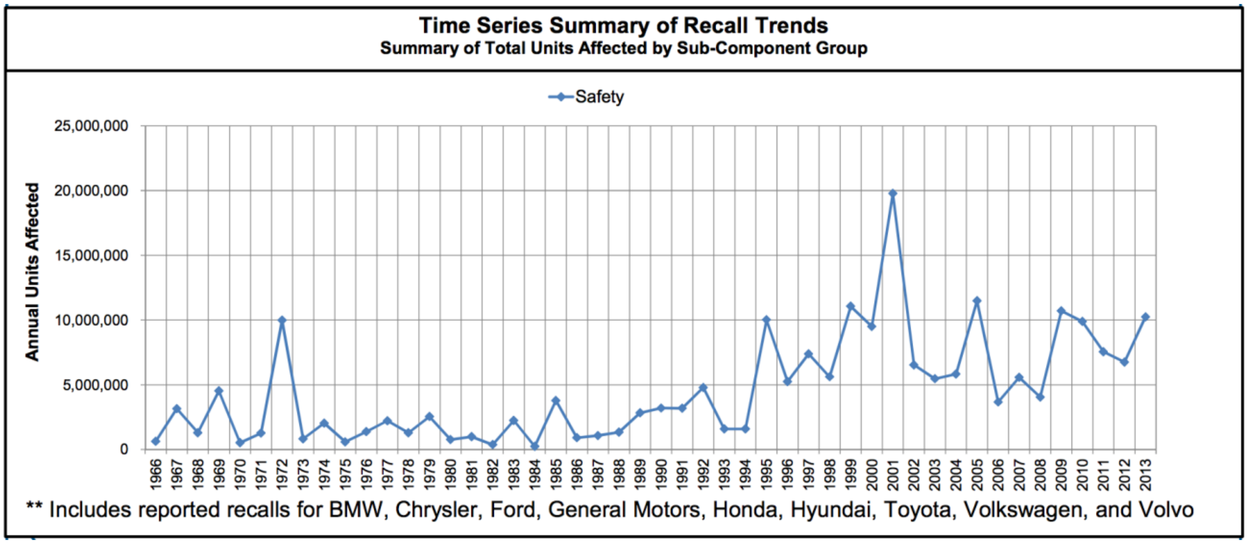
Steinkamp, Neil, and Jake Reed. ***Report on Automotive Warranty Claims and OEM Recalls (2014)***

There are several explanations for why auto recalls have increased in the U.S. First of all, more vehicles are being sold and vehicles are becoming more complex every year. Cars continue to advance in technology and equipment over time. A report by the Society of Automotive Analysts (SAA) explained, “The rise in non-engine and electrical related recalls suggests an increasing impact from vehicle technology” (Steinkamp et al. 2014). This means cars are being produced with more complicated parts, increasing the chance that a recall will occur on these pieces of equipment.

In addition, auto manufacturers are saving money in production by using interchangeable parts, or parts that are used in multiple models. Using interchangeable parts is not a new concept. Henry Ford used interchangeable parts and an assembly line in the early 1900's in order to maximize production and reduce costs. Designing and testing parts is an expensive process, so producing one ignition switch for all models is cheaper than designing a unique ignition switch for each model. Interchangeable parts save time and money in the production of cars. However, when one part is recalled it can potentially affect millions of vehicles across multiple lines rather than just one.

Along with using interchangeable parts, auto manufacturers also outsource many of the parts that go into their cars. Outsourcing parts can be cheaper for the manufacturer. However, it can also increase the chance of a recall occurring since the manufacturer does not have total control over the production and quality of these parts. The SAA report notes that, "Increasing number of OEM/supplier collaboration agreements" and "automakers' increasing efforts to recover costs from suppliers" are both factors (Steinkamp et al., 2014). Manufacturers are not only outsourcing; they are pushing for parts to be made more cheaply by the subcontractors. Figure 2 below displays the total vehicles affected by a sub-component group recall from 1996-2013 for nine of the largest manufacturers.

Figure 2: Time Series Summary of Recall Trends



Steinkamp, Neil, and Jake Reed. *Report on Automotive Warranty Claims and OEM Recalls (2014)*

Finally, an additional reason for the increase in auto recalls is due to regulators punishing auto manufactures for not delivering recall data quickly enough. For example, Toyota was fined $1.2 billion dollars in 2010 for its handling of the unintended acceleration problems. Attorney General Eric Holder said, "Today, we can say for certain that Toyota intentionally concealed information and misled the public about the safety issues behind these recalls."[1] Penalties such as this one imposed on auto manufacturers are a message to automakers that they need to find and address problems quickly and honestly. Similar penalties will potentially increase the number of recalls auto manufacturers initiate in order to prevent bigger losses to profit and reputation.

[1] http://www.usatoday.com/story/money/cars/2014/03/19/toyota-settlement-unintended-acceleration/6595345/

The increases in the number of vehicles being recalled over time is the motivation behind this paper. Do larger auto recalls mean larger losses for shareholders? Auto recalls involve substantial costs for manufacturers. Direct costs associated with a recall include the cost of notifying consumers as well as all the costs associated with correcting the defects. These direct costs are difficult to measure since recall announcements are not required to give estimated repair costs per vehicle. However, direct cost per vehicle can vary significantly. Indirect costs include the damage done to the reputation of the manufacturer that can lead to reduced sales or prices in the future. These indirect costs are more long-term in nature. This paper will examine whether or not a significant negative relationship exists between the number of vehicles recalled per month and the abnormal return for shareholders. In the next section previous literature on market reactions to auto recalls will be discussed.

CHAPTER III

LITERATURE REVIEW

Equity responses to auto recalls have been examined in previous literature by several researchers. The findings have been somewhat ambiguous. With the magnitude of auto recalls, researchers tend to select a relatively small sample to study, which might explain the varying results. For example, Jarrel and Peltzman (1985) found that shareholders suffered significant losses from the recall announcements. They used a sample of only 116 "major recalls" that occurred between 1967 and 1981. They analyzed cumulative excess returns for different sized windows surrounding recall announcements. Jarrel and Peltzman (1985) also found significant spillover effects on competitor's stock prices.

Interestingly, Hoffer, Pruitt and Reilly (1988) revisited Jarrel and Peltzman's work and found errors in the data set. They made some revisions and found that "little significant evidence remains indicating that security markets penalize shareholders for an automotive recall by driving down share prices" (Hoffer et al. pp.669). In another paper Hoffer, Pruitt, and Reilly (1987) found significant negative abnormal returns surrounding the announcement of "severe" safety recalls.

Barber and Darrough (1996) examined 507 recalls for six manufacturers from 1972-1992. They found significant shareholder losses surrounding recalls for the offending firm. However, they did not find significant effects on competitor's stock prices. Their finding conforms to the results of Jarrel and Peltzman (1985) that recall campaigns affect the shareholder value of the announcing firm, but it contradicts the conclusion that competitors are affected. However, this contradicts the finding of Hoffer et al. (1988) who did not find significant shareholder losses to the announcing firm.

In more recent literature, Rupp (2001) examined whether or not government-initiated recalls are more damaging than manufacturer-initiated recalls for shareholders. In doing so Rupp (2001) found significant equity losses surrounding recall announcements but did not find a significant difference in effects between the initiator of the recall. In this analysis, Rupp used recall data for six manufacturers from 1973-1998. In another paper, using the same data, Rupp (2003) examined the attributes of a costly recall. He found that the number of vehicles recalled provided little explanatory power of abnormal returns for manufacturers. Given these results, Rupp (2003) suggested that the direct recall costs are minimal. Rupp’s results indicate that shareholder losses are more sensitive to the component category being recalled rather than to the size of the recall.

Given the substantial increases in the amount of vehicles being recalled as discussed earlier, this paper looks to readdress the effect the number of vehicles recalled has on the manufacturer’s abnormal return. This paper differs from previous literature on two fronts. First of all, abnormal return is calculated month to month rather than using a 2 or 3-day window. Also, this paper focuses more on recent auto recall data from 2005 to 2014.

CHAPTER IV

DATA AND METHODOLOGY

In order to capture a potential relationship between the number of vehicles recalled per month and monthly abnormal return, two techniques will be used. First, a series of ordinary least squared regressions will be estimated. For each manufacturer selected, abnormal monthly return is regressed on the number of vehicles recalled per month. The expectation is that the coefficient on the number of vehicles recalled will be negative and statistically significant. If this were the case it would indicate that as the number of vehicles recalled increases, the abnormal return decreases. Later, control variables are added to the regressions to see how it affects the results. The main equations I will be estimating are shown below:

1. $AR_{it} = a_i + B_1 \ln Total\ Veh\ Recalled_{it} + \varepsilon_{it}$

   and

2. $AR_{it} = a_i + B_1 \ln Veh\ Recalled(mfr)_{it} + B_2 \ln Veh\ Recalled\ (gov)_{it} + \varepsilon_{it}$

Where AR = Abnormal Return, I = manufacturer, t = month, (mfr) = manufacturer initiated, and (gov) = government initiated.

Second, a series of Welch[2] mean comparison t-tests will be conducted. The purpose of these tests is to look for differences between mean abnormal returns in different groups of months classified by the number of vehicles recalled. The first test will compare months with zero recalled vehicles to months with greater than zero vehicles recalled. The second test will compare months in which the number of vehicles recalled is greater than the median verses less than the median. The third test will compare months where the number of vehicles recalled is in the top 25th percentile versus the bottom 75th percentile. In the second and third tests, months in which zero vehicles were recalled are omitted. Welch's t-test is used since it does not require the assumption of equal variance and sample size. Next, the data collection and manipulation will be addressed before discussing the results and interpretations.

Data for auto recalls is available online from the NHTSA recall database[3]. The NHSTA was established by the Highway Safety Act of 1970 and is responsible for setting and enforcing safety performance standards for motor vehicles and motor vehicle equipment. They also keep records on automobile recalls in a publicly available dataset. The NHTSA has recorded all U.S. auto recalls since 1966. For each auto recall the NHTSA records the manufacturer, year, make, and model. The dataset also includes details about each recall, including the initiator of the recall, dates regarding the status of the recall, a defect summary, and the potential number of units affected. This paper focuses on the "number of units affected" variable since it indicates the magnitude of the

[2] Welch, B. L. (1947). The generalization of `Student's' problem when several different population variances are involved. *Biometrika, 34*(1), 28-35. doi:10.2307/2332510

[3] http://www-odi.nhtsa.dot.gov/downloads/flatfiles.cfm

recall. For ease of reading the "number of units affected" variable will be referred to as the number of 'vehicles recalled' throughout the paper.

This paper uses a sample of five manufacturers including both domestic (General Motors and Ford) and Japanese manufacturers (Honda, Nissan, and Toyota). According to Edmunds[4], these five manufacturers accounted for 65.8 percent of the U.S. market share in January 2015. The sample is limited to 117 monthly observations ranging from April 2005 to December 2014 with the exception of General Motors. Due to General Motor's Chapter 11 reorganization in 2009, all stock price data prior to December 2010 is unavailable. Due to this issue the analysis for GM is limited to 49 monthly observations.

This paper uses monthly observations in order to analyze whether or not having larger auto recalls is more damaging for the shareholder's monthly abnormal return. To accomplish this, the auto recalls are aggregated into monthly observations, rather than analyzing the individual effects of each recall like previous literature has done. The NHTSA dataset includes the date the owner is notified for each individual recall. The number of vehicles recalled is aggregated into months by the date the owner is notified while keeping government and manufacturer initiated recalls separate. By aggregating the recalls separated by initiator, we have the total vehicles affected by recall(s) per month. After aggregating the data, we are left with five monthly time series data sets, one for each manufacturer. Table 1 below displays the average, minimum and maximum number of vehicles affected by recalls per month during the sample period. The number of

[4] http://www.edmunds.com/industry-center/data/

vehicles affected ranges from zero to a maximum of over 6.5 million in one month for General Motors.

Table 1: Number of Vehicles Affected by Recall(s) per Month (Apr 2005-Dec 2014)

	n	Manufacturer Initiated			Government Initiated		
Manufacturer	**Months**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**
GM	49	516,528	0	6,576,706	210,664	0	2,519,424
Ford	117	63,867	0	1,572,829	196,671	0	4,500,000
Nissan	117	64,969	0	1,248,032	22,297	0	665,210
Toyota	117	189,369	0	4,445,109	105,868	0	3,300,008
Honda	117	64,969	0	1,248,032	22,297	0	665,210

Since the number of vehicles recalled has such a large range, the natural logarithm is used in the statistical analysis. This will make interpretations easier as well. For each manufacturer, monthly stock prices were collected from Yahoo Finance for the sample time periods. Monthly returns for each manufacturer were calculated using the following equation:

$$R_{monthly} = \frac{R_t - R_{t-1}}{R_{t-1}} * 100$$

In order to calculate abnormal returns, the S&P 500 Index data were also collected from Yahoo Finance. Monthly returns for the S&P 500 were calculated using the last equation above. The abnormal return is calculated using the market model equation where:

$$R_{it} = a_i + B_i R_{mt} + \varepsilon_{it} \quad , \quad \text{where t = month, I = } i\text{th stock}$$

This ordinary least squared regression calculates the return for each manufacturer that can be explained by the overall movement of the market. The results from this initial regression are shown below in Table 2.

Table 2: Market Model Results Using S&P 500

Manufacturer	**Coef.**	**t-stat**	**Adj. R2**	**n**
GM	1.71***	5.66	0.39	49
Ford	2.1***	6.60	0.27	117
Nissan	1.37***	8.75	0.39	117
Toyota	0.68***	5.82	0.22	117
Honda	0.80***	6.35	0.25	117
*** p<0.01, ** p<0.05, p* p<0.1				

The residual from the above equation is equal to the abnormal return for the *i*th manufacturer's stock. The residual represents the return for the manufacturer that cannot be explained by the overall movement of the market. This is what will be used in the main OLS regressions noted above by the term AR.

Several control variables were collected from the St. Louis Federal Reserve Economic Data website which will be used in the OLS regressions[5]. These variables are listed below in Table 3 with their summary statistics. Not all control variables were significant for all manufacturers. They are used to see how the initial significant results change with the addition of controls.

[5] http://research.stlouisfed.org/fred2/

Table 3: Control Variables Summary Statistics

Variable	n	Mean	Std. Dev	Min	Max
% chg oil prices	117	0.301	8.722	-28.200	22.600
% chg gas prices	117	0.213	7.134	-29.600	16.800
% chg CPI private transp.	117	0.130	2.054	-10.800	6.200
Fed Funds Rate	117	1.585	2.039	0.100	5.300
% chg housing index	117	-0.044	0.924	-2.000	1.700
% chg disp. Income	117	0.166	0.911	-5.900	4.800
%chg auto sales	117	0.191	6.540	-35.800	28.100

Finally, for the mean comparison tests, the mean abnormal return is calculated for a series of groupings. The first grouping is months with zero recalled vehicles as opposed to months with any number of recalled vehicles. The second grouping is months in which the number of recalled vehicles is less than or more than the median number of recalled vehicles. The third grouping is months in which the number of recalled vehicles is less than or more than the 75th percentile of the number of recalled vehicles. This is done separately for each manufacturer. Mu (μ) is the average abnormal return for each group and n represents the number of months in each group. The median and 75th percentile number of vehicles recalled is calculated using only months in which recall(s) have occurred. The results are shown in Table 4 below.

Table 4: Mean Abnormal Returns for Different Groups

VA=Vehicles Affected	*GM*		*Ford*		*Nissan*		*Toyota*		*Honda*	
n=months	**n**	**μ**	**n**	**μ**	**n**	**μ**	**n**	**μ**	**n**	**μ**
No recall	5	-5.39	17	0.65	44	-0.12	38	-0.81	44	-0.27
Recall	44	0.61	100	-0.11	73	0.07	73	0.39	73	0.16
VA>median	22	1.13	50	-2.28	37	1.02	39	0.85	37	0.07
VA<median	22	0.09	50	2.06	36	-0.35	40	-0.06	36	0.26
VA>75th %	11	1.04	25	-0.11	19	2.68	19	1.32	19	1.31
VA<75th %	33	0.47	75	-0.11	54	-0.84	60	0.07	54	-0.24

The null hypothesis and alternative hypothesis for the mean comparison t-tests are shown below. The null hypothesis asserts that the difference in means is equal to zero. The alternative hypothesis asserts that the difference in means is not equal to zero. In the next section, I will discuss the results for both the OLS regressions and mean comparison tests. Additionally, interpretations will be made based on these results.

3. $Ho: \mu_1 - \mu_2 = 0$
4. $Ha: \mu_1 - \mu_2 \neq 0$

CHAPTER V

RESULTS AND INTERPRETATION

First, the results for the ordinary least squared regressions will be discussed. The results for equation 1 and 2 are shown in Table 5 below. Model 1 is a regression of abnormal return on the log of vehicles recalled separated by the initiator (MFR/GOV). Model 2 is a regression of abnormal return on the log of total vehicles recalled per month. As can be seen, there is only one statistically significant result in Model 1, namely Ford. Interestingly, only the number of vehicles recalled which were initiated by the manufacturer is significant for Ford. The coefficient of -0.779 is interpreted in the following manner: For a 10 percent increase in the number of vehicles recalled we expect a 7.8 percent decrease in abnormal return. In Model 2, GM and Toyota have statistically significant coefficients; however, they are only statistically significant at the 10 percent level. Also, both have a positive sign suggesting a positive relationship between the number of vehicles recalled and abnormal return. These results are the opposite of what was expected.

Table 5: OLS Results Excluding Control Variables

Dependent Variable=AR	*GM*	*Ford*	*Nissan*	*Toyota*	*Honda*
MODEL 1					
ln Vehicles Recalled(MFR)	0.033	(0.779)***	0.116	0.048	0.078
	0.150	(2.700)	0.910	0.520	0.760
ln Vehicles Recalled(GOV)	0.252	0.276	0.007	0.147	(0.109)
	1.460	1.110	0.040	1.500	(0.830)
R2	0.045	0.067	0.007	0.025	0.012
MODEL 2					
ln Total Vehicles Recalled	0.383*	(0.362)	0.055	0.148*	0.053
	1.760	(1.240)	0.440	1.690	0.520
R2	0.062	0.013	0.002	0.024	0.002
*** p<0.01, ** p<0.05, p* p<0.1					

Adding control variables to Model 1 did not change anything for GM, Nissan, Toyota and Honda. As expected the variables of interest remain statistically insignificant. The significant result for Ford, however, remained significant with the addition of control variables and the results are shown below in Table 6.

Table 6: Ford Model 1 OLS Results Including Controls

Independent Variables	**Coef**	**T-stat**
ln Vehicles Affected (MFR)	(0.679)**	-2.38
%change oil prices (L1)	0.53***	2.810
%change Housing Index	(3.54)**	(2.260)
%change CPI (private transp.)	(1.45)*	(1.880)
%change autosales (L2)	(0.309)	(1.530)
FF Rate (L3)	(1.17)*	(1.670)
constant	6.09**	2.490
*** p<0.01, ** p<0.05, p* p<0.1	R2=0.18	

As can be seen, when control variables are added the coefficient on the number of vehicles affected by manufacturer initiated recalls is now only significant at the 5 percent level. Before, it was significant at the 1 percent level. Furthermore, the coefficient is slightly smaller in magnitude. Now, a 10 percent increase in vehicles affected by manufacturer-initiated recalls results in a -6.8 percent effect on abnormal return. Without access to manufacturer-specific monthly data, it is difficult to create a model which explains a large percentage of the abnormal return for a specific manufacturer. With the inclusion of five significant control variables, the model only obtains an R-squared of 0.18. This indicates that this model only accounts for about 18 percent of the variation in abnormal return. The purpose of this is to show how the magnitude and significance would change in a more complete model.

The results for the mean comparison t-tests are shown in Table 7 below. The null hypothesis for this test is that the means are not significantly different from each other. Interestingly, we cannot reject the null hypothesis for all groups and all manufacturers. There is not a statistically significant difference in the mean abnormal return for months with a relatively large number of vehicles being recalled. These results correspond with the results from the OLS regressions so it is not surprising. Even months in which the number of vehicles recalled is in the top 25^{th} percentile the mean abnormal return does not have a statistically significant difference from months in the lower 75^{th} percentile.

Table 7: Mean Comparison T-Test Results by Manufacturer

	GM		*Ford*		*Nissan*		*Toyota*		*Honda*	
Hypothesis Tested	**Answer**	**T-stat**	**Answer**	**T-stat**	**Answer**	**T-stat**	**Answer**	**T-stat**	**Answer**	**T-stat**
Is the mean AR different in months when recalls occur?	No	-1.89	No	0.30	No	-0.13	No	-1.09	No	-0.40
In months where recalls do occur:										
Do months with relatively larger recall(s) have different mean AR?										
When # vehicles affected > median size	No	-0.52	No	1.41	No	-1.24	No	-0.76	No	0.13
When # of vehicles affected > 75th Percentile	No	-0.28	No	0.00	No	-1.86	No	-0.87	No	-0.94

*** p<0.01, ** p<0.05, p* p<0.1

CHAPTER VI

CONCLUSION

Although the number of vehicles being recalled is continually increasing, the magnitude of recalls does not appear to have an effect on shareholder's monthly abnormal return. In both tests, it appears that the number of vehicles recalled does not play a role in determining monthly abnormal return for manufacturers. Ford, the only exception, appears to have a negative relationship between manufacturer-initiated recalls and abnormal return. With a 10 percent increase in the number of vehicles recalled by Ford, shareholders experience a -7.8 percent effect on monthly abnormal return. However, the effect diminishes with the addition of control variables and it is difficult to determine how significant it would be in a more complete model. Based on the results from the mean comparison tests we are unable to conclude that larger recalls have a significant effect on abnormal return for all five manufacturers.

The results are not that surprising since they correspond to the findings of Rupp (2003), who found that the number of vehicles recalled provided little explanatory power of abnormal returns even in a 2-day window surrounding the recall announcement. Rupp (2003) suggests that a reason for this is that direct costs to the manufacturer are minimal. Direct costs include the cost of repairs and notifying customers. It appears as if these costs are minimal compared to other indirect costs, such as the damage to a firm's reputation. Other attributes of recalls, as Rupp (2003) suggested, such as which component is recalled are likely more important in determining the abnormal return.

There are potentially some problems with aggregating the data into monthly observations. It is possible that the effects of the recalls are being washed out by other events throughout the month. There are numerous events that can cause a manufacturers stock price to change throughout the month. Events such as financial statements being released, negative or positive news related to the company, sales forecasts, economic conditions, insider information and many other factors can have a substantial effect on the monthly abnormal return. This is partly why the majority of previous literature examines 2 or 3-day windows surrounding recall announcements. This analysis could be improved by doing this but unfortunately with the magnitude of recalls it would likely take years to organize.

Another potential issue in drawing major conclusions from this analysis is the time span and scope of the sample. This paper analyzes just five manufactures over a 10 year time span. Ideally, all manufacturers would be included across the entire time span of the NHTSA recall dataset. This is potentially possible for future research given more time. The magnitude of recalls presents several issues. Investors may not react to each recall announcement since there are so many, and many never make it into the news. Also, given the mixed results from previous literature, it appears that the sample selection is a large determinant of the results found. Future potential research on this topic would include a larger time span with more manufacturers. Also, if the effects of recalls could be isolated further, the accuracy of the results could be improved.

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