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Confirmations and Contradictions

Product Reliability and Firm Value: The Experience of American and Japanese Automakers, 1973–1992

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I. Introduction

In a typical month, several recall campaigns of motor vehicles are announced by automobile manufacturers. They are carried out to correct defective vehicles. Whether safety- or pollution-related, recalls imply that the products made available to consumers are not what they were supposed to be. A question arises then as to whether and how much the offending automakers are affected by these recall campaigns. The answer to this question has been ambiguous in the literature. We have two purposes in this paper: First, on the basis of a longer and broader database, we offer additional and more conclusive evidence that documents significant and negative market reactions to automobile recall announcements. Our finding therefore helps to resolve the ambiguity in the literature on this question. Second, we offer new evidence on Japanese automobile companies. They too suffer from significant and negative stock market reactions, but the incidence of recalls is less frequent. Perhaps, as a result, the magnitude of the stock market reaction to each recall is somewhat larger. Nevertheless, because recalls are much less frequent, the total losses

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in shareholders' wealth are smaller for the Japanese automakers than for their American competitors.

Our analysis is based on the recall experience in the United States during the period 1973–92 of six automakers: three American (Chrysler, Ford, and General Motors) and three Japanese automakers (Honda, Nissan, and Toyota). These six automakers together constituted nearly 90 percent of the U.S. motor vehicle market (passenger cars and trucks) during our sample period. Although the total market share by these six automakers has been relatively stable over the period, the composition among the six has changed significantly. Most important, the market share by the American manufacturers has declined from 81.3 percent to 64.6 percent over the 20-year period. The rise in market share by the Japanese automakers has been attributed to various factors such as the type of auto models supplied (e.g., smaller and more fuel-efficient) and overall quality of vehicles (e.g., repairs required are less frequent). Of course, the model specification of each automobile is readily observable. The overall quality of cars, however, is much harder to discern.

High ratings by organizations such as J. D. Power and Consumers Union can establish that a product is of high quality. Presumably, the sales of a company whose cars routinely receive good ratings will increase, and the company will end up with higher earnings. A company with superior management, operational control, and quality control will produce cars with attributes that are valued by consumers. Recalls reflect a lack of quality control in underlying operations. Recalls clearly involve substantial costs, both direct and indirect. The direct costs to automakers include the cost of notification and the cost of correcting defects, both of which are short-run in nature.¹ The owners of recalled vehicles suffer from inconvenience, the potential risk from operating defective vehicles, and a possibly substantial loss in the resale value of their vehicles.

Automakers, in addition, are likely to experience indirect and long-run costs. An automaker that produces less reliable vehicles is expected to have lower profits because of reduced sales or reduced prices or both. Klein and Leffler (1981) argue that this potential loss reflects the loss of quasi rents that the firm is expected to receive

¹ The direct cost of fixing defects per vehicle appears to vary significantly. For example, the *Wall Street Journal* reported two separate recalls made by Ford, indicating that the costs were \$30 and \$1,875 per vehicle. The second recall appears to be an exceptionally serious and costly one. These reports on direct costs, however, are exceptions rather than a norm, in that most announcements do not give estimated costs. Clearly, the total direct cost of recalls also depends on the number of vehicles involved. A recent GM case in November 1994 involved 5–6 million 1993 trucks. The estimated cost to fix each truck was about \$100, resulting in a total direct cost of \$500–\$600 million.

from its "brand name capital."² It is difficult to estimate directly the magnitude of the loss of brand name capital due to a recall campaign, but the expected (negative) consequences would be anticipated and incorporated in the stock market valuation of the automakers.

Thus lower stock market valuation of a firm's equity is another cost, possibly a large one. The hypothesis that the stock market imposes a penalty on the release of news about corporate misconduct or misrepresentation has been empirically tested for various industries and events, for example, corporate fraud (Karpoff and Lott 1993); cease and desist orders associated with fraudulent advertising (Mathios and Plummer 1989); drug recalls (Dranove and Olsen 1994; Jarrell and Peltzman 1985);³ and airline crashes (Borenstein and Zimmerman 1988; Mitchell and Maloney 1989).⁴ These results suggest that the stock market quickly, and in a discriminatory manner, reacts negatively to news that impugns the reputation of a firm.

As to the automobile industry, however, the results of previous research on the relation between news of recalls and shareholder wealth have been inconclusive. Analyzing 116 recall campaigns made by American automakers during the period 1967–81, Jarrell and Peltzman (1985) document a significant negative impact on shareholder wealth when a recall campaign was announced by Chrysler, Ford, or General Motors. Furthermore, they find statistically significant spillover effects for competitor firms. However, Hoffer, Pruitt, and Reilly (1988) reclassify and reanalyze the Jarrell and Peltzman data for the period 1975–81 and find "little" significant valuation effects, for either announcing firms or competitor firms.

We expand the data set by including a longer time period (1973–92) and three Japanese automakers (Honda, Nissan, and Toyota) in addition to the Big Three. Our sample consists of 573 recall campaigns reported in the *Wall Street Journal* involving nearly 141 million vehicles.

II. Background of Automobile Recall Campaigns

In 1966, Congress passed the National Traffic Vehicle Safety Act, empowering the federal government to set national safety standards

² Losses in equity value over and above the direct cost have also been referred to as a loss of "goodwill" (Jarrell and Peltzman 1985), a "general loss of faith" (Dranove and Olsen 1994), a loss of "trademark capital" (De Alessi and Staaf 1994), and a "reputation penalty" (Karpoff and Lott 1993).

³ Dranove and Olsen attribute the negative market response to an increase in the cost of compliance with more stringent drug testing, whereas Jarrell and Peltzman interpret the response as a loss of goodwill.

⁴ Borenstein and Zimmerman argue that the negative market response is small relative to the total social cost of those crashes, whereas Mitchell and Maloney find that negative market reactions occur only for those crashes in which airlines were found at fault.

for motor vehicles.⁵ This act mandates that manufacturers of motor vehicles, both domestic and foreign, notify the Department of Transportation, vehicle owners, and dealers about safety-related defects. On the receipt of the notice, the National Highway Traffic Safety Administration (NHTSA) posts the notice in the Technical Reference Library. According to the NHTSA reports, during the 1973–92 period, there were 4,399 recall campaigns involving over 140 million motor vehicles. The majority (3,497) of these recall campaigns were made by American companies. Although less than half of these campaigns were conducted by the Big Three automakers, the number of vehicles recalled by the Big Three totaled 122 million vehicles.

Many of the major recall campaigns are publicized widely. The *Wall Street Journal* (WSJ) publishes reports on recalls by various automakers regularly, usually on the basis of the press releases prepared by the automakers.⁶ Some of these recalls are safety-related and are filed with the NHTSA. Some recalls are due to defects related to fuel efficiency and emission standards, which are under the jurisdiction of the Environmental Protection Agency (EPA).

Our analysis focuses on the WSJ announcements, since they are the major public news releases on recalls.⁷ Hoffer et al. (1987) examined the stock market reactions to the NHTSA filing dates and found no statistically significant reactions. A typical WSJ article on a recall identifies the auto manufacturer, the specific model, the number of vehicles involved, and the reason for the recall. Some of the recalls have been *ordered* by the NHTSA or the EPA, but most of them are the result of voluntary compliance by automakers with the NHTSA or EPA guidelines. A few recalls involved fewer than 100 vehicles, but most of them were much larger (with the average being 241,233 vehicles). The largest recall was 6.4 million vehicles (GM, February 24, 1981). The defects that triggered these recalls vary from relatively

⁵ Section 151 of the 1966 act, as amended, requires that if a manufacturer “(1) obtains knowledge that any motor vehicle or item of replacement equipment manufactured by him contains a defect and (2) determines in good faith that such defect relates to motor vehicle safety; or determines in good faith that such vehicle or item of replacement equipment does not comply with an applicable Federal motor vehicle safety standard prescribed pursuant to section 103 of this Act; he shall furnish notification to the Secretary and to owners, purchasers, and dealers, in accordance with section 153, and he shall remedy the defect or failure to comply in accordance with section 154.”

⁶ The press releases are made after filing, if required, with the NHTSA. Thus the WSJ reports appear later than the NHTSA filing dates, sometimes by 1 day, but more frequently by several days to weeks.

⁷ The coverage of motor vehicle recalls by the NHTSA or the WSJ is not complete. For example, in 1981, GM notified the NHTSA of 15 separate recall campaigns involving 6,473,445 vehicles. The *WSJ Index* had nine reports on GM recalls, of which six were NHTSA-reported campaigns (with one report covering two campaigns). The numbers of vehicles reported in the *WSJ* are often rough and, in some cases, differ substantially from the numbers reported to the NHTSA.

minor to serious ones. Rusty fenders (Honda, March 23, 1984) and ill-fitting shoulder belts (Nissan, March 19, 1991) are examples of the former; brake problems (GM, February 10, 1983) and engines prone to fire (GM, March 14, 1983) are examples of the latter.

III. Data and Methodology

A. Recall Data

We compile data on recalls of automobiles and trucks in the United States by each of our six sample companies from the *WSJ Index*.⁸ We define the day before each recall report in the *WSJ* as the public announcement date.

During our sample period, 1973–92, American automakers experienced a higher number and a higher rate of vehicle recalls. The *WSJ* reported 507 recall campaigns by the three U.S. automakers and 66 recall campaigns by the three Japanese automakers (see col. 4 of table 1). We also compile data on the total number of vehicles recalled by each of the six companies. On average, over our 20-year sample period, the number of vehicles recalled in each calendar year by the Big Three was equivalent to 50 percent (for Chrysler), 49 percent (for Ford), and 45 percent (for GM) of total vehicles sold in the United States in the preceding three years by each automaker. In contrast, on average the recall rate by the three Japanese firms was equivalent to 37 percent (for Honda), 25 percent (for Nissan), and 21 percent (for Toyota). These differences are statistically significant with a Wilcoxon rank-sum test statistic (p -value $< .01$). Thus the recall data support the common perception that Japanese vehicles are more reliable than their American counterparts.

Auxiliary analyses also reveal that neither the American nor the Japanese companies significantly reduced their rates of recalls (as defined in the preceding paragraph) from the first decade of our sample period (1973–82) to the second (1983–92). In addition, the Japanese maintained significantly lower rates of recalls during both decades.⁹ Thus the recall data do not support the common perception that American automakers have closed the quality gap during the 1980s.

B. Returns Data

To estimate the wealth effect associated with a recall campaign for each automaker, we calculate an abnormal stock return surrounding

⁸ Honda had 19 recalls of motorcycles during the 20-year period. We have excluded these recalls from our analysis.

⁹ The details of these analyses are contained in the working paper version of this paper (Barber and Darrough 1995).

TABLE 1

SHAREHOLDER WEALTH EFFECTS OF AUTOMOTIVE AND TRUCK RECALLS FOR LARGE U.S. AND JAPANESE AUTO COMPANIES, 1973-92

	Mean Abnormal Return (1)	<i>t</i> -Statistic (2)	Percentage < 0 (3)	Number of Recalls (4)
Chrysler	-1.29	-4.11	73.8*	84
Ford	-.19	-1.35	56.6*	226
GM	-.05	-.34	52.3	197
U.S. companies	-.32	-3.16	57.8*	507
Honda	-1.36	-2.37	75.0*	16
Nissan	-.07	-.16	51.5	33
Toyota	-1.27	-2.06	76.5*	17
Japanese companies	-.69	-2.31	63.6*	66

NOTE.—Abnormal returns for U.S. companies are common stock returns less a value-weighted NYSE/AMEX market index for the day of and the day preceding the recall announcement in the *WSJ*. Abnormal returns for Japanese companies are dollar-denominated ADR returns less an equally weighted index of all Japanese ADRs for the day of and the day preceding the recall announcement in the *WSJ*. Test statistics are based on the cross-sectional standard deviation of abnormal returns.

* Proportion of abnormal returns is significantly different from 50 percent at the 5 percent significance level.

the announcement of each recall campaign. The abnormal returns for each automaker are computed using return data from the Center for Research in Security Prices (CRSP). The return data for the U.S. auto manufacturers represent common stock returns, and the return data for the Japanese companies represent returns on American Depository Receipts (ADRs). The daily returns are dollar-denominated and are continuously compounded. It is straightforward to demonstrate that a simple market adjustment yields a measure of abnormal return that is independent of the currency used to calculate returns.

Two market indexes are employed to measure abnormal returns. For the U.S. automakers, we use a value-weighted New York Stock Exchange/American Stock Exchange market index. For the Japanese automakers, we use an equally weighted index of all ADRs for Japanese-based companies, excluding the three Japanese auto manufacturers.¹⁰ The number of companies in this index ranges from 11 in the early 1970s to 23 in the mid 1970s through 1992. We also considered the use of a broad-based Japanese market index but rejected its use in favor of the ADR index for two reasons. First, when we regressed the monthly returns of the Japanese auto companies on the return for a broad-based market index compiled by the Japan Securities Research Institute, the R^2 's of the regressions were uniformly lower than those employing the return for the ADR market index.

¹⁰ The daily market values of the included firms were not available to compute a value-weighted index.

This result likely occurs because the ADR market index is composed of companies that rely on U.S. markets for a significant portion of their business, as the Japanese automakers do. Second, a broad-based market index would be based on Japanese trading times. Since our event dates are based on *WSJ* reporting, the ADR index is better matched to the public announcements under consideration.

When daily returns for the three U.S. firms are regressed on the U.S. and Japanese market indexes, the coefficient estimates on the U.S. market index are generally slightly greater than one, whereas those on the Japanese market index are generally close to zero and statistically insignificant. The R^2 's for these regressions range from 23 percent (for Chrysler) to 40 percent (for GM). Thus using only the U.S. market index as the benchmark for the American firms is appropriate.

Similarly, when returns for the three Japanese firms are regressed on the U.S. and Japanese market indexes, the coefficient estimates on the Japanese market index are generally close to one, whereas those on the U.S. market index are generally close to zero and statistically insignificant. The R^2 's for these regressions range from 32 percent (for Honda) to 41 percent (for Toyota). Thus using only the Japanese market index as the benchmark for the Japanese firms is appropriate.

On the basis of these results, we employ a simple market adjustment method to measure the abnormal returns for each company. Thus for each firm we measure abnormal returns (AR_{it}) as the equity return (r_{it}) of firm i less the return on the firm's domestic market index (r_{mt}) on trading day t :

$$AR_{it} = r_{it} - r_{mt}. \quad (1)$$

These abnormal returns are used in the empirical tests that follow.¹¹ Cumulative abnormal returns are calculated as the sum of daily abnormal returns.

¹¹ While we considered the use of a market model methodology to calculate abnormal returns, we decided to use the simple market adjustment for two reasons. First, the beta estimates for each of the firms were not stable over time. This being the case, we were concerned that imprecise parameter estimates would lead to erroneous conclusions. Second, the use of the market model would yield abnormal returns that would differ depending on the currency used to measure returns. This is a problem that the use of a simple market adjustment avoids. Brown and Warner (1985) document that the simple market adjustment method yields tests for abnormal returns that are well specified and powerful. Nonetheless, we can report that when a dollar-denominated market model is employed to estimate abnormal returns, the general nature of the results presented here is unaffected.

IV. Results

A. *Wealth Effects for Firms Announcing Recall Campaigns*

In this section, we summarize the wealth consequences of recall campaigns reported in the *WSJ* for U.S. and Japanese shareholders for 1973–92. To estimate the loss in shareholder value associated with recall campaigns for the announcing firm, we calculate mean 2-day cumulative abnormal returns (CARs) as described in Section III for each of the recall campaigns by U.S. and Japanese automakers. We chose a short event window to minimize the effect of contaminating news. Especially for U.S. automakers, hardly a day goes by without there being some articles about them in the *WSJ*. The results of this analysis are summarized in table 1. For both U.S. and Japanese automakers we find that the announcement of a recall campaign has statistically significant valuation consequences. The mean 2-day CAR is -0.32 percent for the U.S. companies and -0.69 percent for the Japanese companies. These results are robust to several alternative sample specifications. For example, the results are valid when emission-related recalls are excluded from the sample, when recalls of fewer than 10,000 vehicles are excluded from the sample,¹² when the market model is used to estimate abnormal returns, or when the event window is expanded to 1 week.¹³

We also investigate whether there is a significant market reaction to the filing of a recall campaign with the NHTSA by estimating the 2-day abnormal returns around the NHTSA filing dates for each of the six companies. The three American automakers filed 975 recall campaigns with the NHTSA during our sample period, and the three Japanese automakers filed 91 recall campaigns. In this analysis, we define the announcement date as the filing date. We find that filings with the NHTSA are met with a 2-day negative market reaction of -0.15 percent for both the American and the Japanese automakers, though the reaction is reliably negative only for the American automakers ($t = -2.05$). However, when we expand to a 5-day event window from the filing date through 4 days following, the results are similar to those documented around the announcement of recall campaigns in the *WSJ*. Over the 5-day event window, there is a significant negative market reaction to recall campaigns by the American

¹² We regressed 2-day abnormal returns on the number of vehicles recalled to determine whether there was a statistically significant relation between the size of a recall campaign and the market reaction. Though the coefficient estimate on the number of vehicles recalled was negative, it was not statistically significant.

¹³ The mean 1-week abnormal return for the U.S. firms is -0.43 percent and for the Japanese firms is -0.56 percent.

automakers (-0.39 percent) and the Japanese automakers (-0.48 percent).¹⁴

Having established the mean result for American and Japanese automakers, we now ask the following three questions: (1) Has the market reaction changed during the last decade? (2) Does the market reaction significantly differ for American and Japanese automakers? (3) Does the market reaction for each of the six companies differ substantially from that of its competitors? To answer these questions formally, we calculate a series of *t*-statistics using the 2-day abnormal returns previously calculated. The results of this analysis are presented in table 2.

The first question requires a two-part answer. For the Japanese companies, we observe no change in the market reaction (the market reaction being significantly negative in both subperiods), but for the U.S. companies the market reaction has been significantly negative only during the first decade of our sample.

Does the lack of market reaction to recall campaigns by U.S. automakers during the second half of our sample suggest that markets are insensitive to signals regarding product reliability for American, but not Japanese, automakers? We suspect not. There are possibly two reasons why the market reaction documented here, particularly for U.S. automakers, may be an underestimate of the total loss in shareholder value associated with the announcement of a recall campaign. First, since motor vehicle recalls are frequent, even without specific information about defective vehicles, the market is likely to anticipate recalls on a regular basis. In that case, we expect that the more recalls a particular automaker makes, the less the impact of a particular recall by the automaker.¹⁵

Second, there is often news about defective vehicles published before the automaker makes formal announcements. The following are examples of such *WSJ Index* items:

April 8, 1983: GM "has been trying to persuade the federal government that it isn't dangerous if the rear wheel and axle fall off, in an effort to avoid a recall."

¹⁴ Of the 975 NHTSA recall campaigns by the three American automakers, 149 were involuntary (15 percent); of the 91 recall campaigns by the three Japanese automakers, 37 were involuntary (41 percent). We also analyze the wealth effects of these involuntary recall campaigns and find a negative 5-day market reaction of -0.40 percent for the American automakers and -0.77 percent for the Japanese automakers, but neither estimate is reliably negative. This lack of statistical significance is likely a result of the significantly reduced sample sizes.

¹⁵ One might wonder whether the *WSJ* coverage of recalls by Japanese automakers is less than the coverage of those by U.S. automakers. Casual comparison of the total number of NHTSA-reported recalls and the number of *WSJ* announcements of safety-related recalls indicates that this is not the case.

TABLE 2

COMPARISON OF U.S. AND JAPANESE ABNORMAL RETURNS SURROUNDING THE ANNOUNCEMENT OF RECALL CAMPAIGNS IN THE *Wall Street Journal*, 1973-92

Question	Answer	<i>t</i> -Statistic	<i>p</i> -Value (Two-Tailed Test)
Was the market reaction to recall campaigns by U.S. automakers different from that by Japanese automakers?	No	1.29	.1983
Was the market reaction to recall campaigns by U.S. automakers different during 1983-92 than during 1973-82?	Yes (less negative)	3.80	.0002
Was the market reaction to recall campaigns by Japanese automakers different during 1983-92 than during 1973-82?	No	.55	.5850
Was the market reaction to recall campaigns by Chrysler different from that of its U.S. and Japanese competitors during 1973-92?	Yes (more negative)	-4.11	.0000
Was the market reaction to recall campaigns by Ford different from that of its U.S. and Japanese competitors during 1973-92?	No	1.47	.1412
Was the market reaction to recall campaigns by GM different from that of its U.S. and Japanese competitors during 1973-92?	Yes (less negative)	2.38	.0176
Was the market reaction to recall campaigns by Honda different from that of its U.S. and Japanese competitors during 1973-92?	Marginally (more negative)	-1.80	.0719
Was the market reaction to recall campaigns by Nissan different from that of its U.S. and Japanese competitors during 1973-92?	No	.76	.4456
Was the market reaction to recall campaigns by Toyota different from that of its U.S. and Japanese competitors during 1973-92?	Marginally (more negative)	-1.69	.0916

NOTE.—The *t*-statistics are based on pooled cross-sectional standard errors. These test statistics are used to answer each of the questions put forth in this table. The results are similar with Wilcoxon rank-sum test statistics or *t*-statistics calculated under the assumption of unequal variances across subsamples.

May 5, 1983: GM "displayed a dazzling array of statistics designed to convince federal safety officials that it is cheaper and safer not to recall some 5.3 million GM cars that may be prone to losing their rear wheels."

July 20, 1987: "Faced with mounting legal trouble over potential ambulance fires, Ford reversed earlier decision and announced a formal safety recall of as many as 16,000 vehicles; action could cost the company as much as \$30 million."

Although the first two are not announcements of recall campaigns, they suggest possible future recalls. The third is an announcement but indicates that there has possibly been a substantial amount of negative information on the vehicle.

As to our second question, we find that the market reaction does not significantly differ for American and Japanese automakers. However, caution should be used in the interpretation of this null result. With only 67 recall campaigns by Japanese automakers covered in the *WSJ*, we suspect that the power of this test is low. Furthermore, as the analysis below suggests, the market reactions appear to differ significantly among the six automakers.

With respect to our third question, at least two companies, and perhaps four, had substantially different market reactions to the announcement of recall campaigns. On average, Chrysler had a significantly more negative reaction, and GM had a significantly less negative reaction. Both Honda and Toyota had marginally more negative reactions than their competitors. The three companies with the more negative market reactions (Chrysler, Honda, and Toyota) had annual recall rates that were on par with (Chrysler and Honda), or substantially better than (Toyota), those of their competitors; the one company with the less negative market reaction (GM) had recall rates that were substantially worse than those of its competitors. This finding is consistent with the hypothesis that the market anticipates future recalls on the basis of the past recall frequency.

Finally, we estimate the mean and cumulative dollar loss in the market value of equity to the shareholders of each firm over our 20-year sample period. The month-end nominal dollar-denominated market value of equity for the three U.S. firms is calculated as price per share times shares outstanding, as reported by CRSP. The month-end nominal dollar-denominated market value of equity for the three Japanese firms is calculated as price per share (in yen) times shares outstanding, as reported by Datastream, multiplied by the corresponding dollar-yen exchange rate. The real market value of equity for the three U.S. (Japanese) firms is then calculated by deflating the nominal figures by the U.S. (Japanese) consumer price index (CPI)

with a 1990 base year. The dollar loss for each recall campaign announced in the *WSJ* is calculated as the beginning-of-month real dollar-denominated market value of equity multiplied by the mean 2-day abnormal return for the same firm. The mean and cumulative dollar losses are calculated by averaging and summing across all recall campaigns. The results of this analysis are reported in table 3.

With the exception of Nissan (\$5 million), on average the American automakers lost less per recall campaign, with dollar losses ranging from \$15 million to \$47 million (all in 1990 dollars). Honda and Toyota, the two companies with the fewest recalls during our sample period, on average lost \$95 million and \$251 million per announcement.

However, the higher incidence of recall campaigns for the Big Three translates into higher cumulative dollar losses. The three American automakers each lost \$2.9 billion (GM), \$4 billion (Chrysler), and \$5.7 billion (Ford) in market value from the announcement of recall campaigns. These cumulative losses represent 49 percent (Chrysler), 30 percent (Ford), and 14 percent (GM) of the real market value of equity as of 1992 year end. In contrast, the Japanese automakers each lost \$167 million (Nissan), \$1.5 billion (Honda), and \$4.3 billion (Toyota). Though the cumulative loss for Toyota is large, Toyota is larger than GM and Ford combined as measured by the 1992 market value of equity. These cumulative losses represent 15 percent (Honda), 2 percent (Nissan), and 11 percent (Toyota) of the market value of equity for the Japanese firms as

TABLE 3

MEAN AND CUMULATIVE IMPACT OF ANNOUNCEMENT OF RECALL CAMPAIGNS ON REAL DOLLAR-DENOMINATED MARKET VALUE OF EQUITY (1990 Base Year) FOR LARGE U.S. AND JAPANESE AUTO COMPANIES, 1973-92

	Mean Loss per Announcement (\$000)	Cumulative Loss, 1973-92 (\$000)	Real Market Value of Equity, 1992* (\$000)
Chrysler	47,496	3,989,676	8,003,078
Ford	25,187	5,692,156	18,837,444
GM	14,817	2,918,973	20,457,152
Honda	94,806	1,516,894	10,090,372
Nissan	5,052	166,711	10,669,186
Toyota	250,611	4,260,379	40,298,560

NOTE.—The mean market value loss per announcement of recall campaigns is calculated by multiplying the mean 2-day abnormal return (see table 1) by the beginning-of-month dollar-denominated real market value of a firm's equity. The real market value of equity for the U.S. companies is calculated as price per share times shares outstanding deflated by the U.S. CPI with a base year of 1990. The real market value of equity for the Japanese companies is calculated as price per share times shares outstanding times the dollar-yen exchange rate deflated by the Japanese CPI with a base year of 1990.

* The nominal dollar-denominated market value of equity for U.S. (Japanese) firms is deflated by the U.S. (Japanese) CPI with a base year of 1990.

of 1992. These results indicate that though all six firms suffered equity losses from the announcement of recall campaigns, the Big Three suffered significantly larger losses during our sample period.

The magnitude of the equity losses is substantial. Nonetheless, we conjecture that our estimates do not capture the true magnitude of equity losses for three reasons. First, since some of the recall campaigns are well anticipated, the true magnitude is not fully captured by a 2-day event window.¹⁶ Second, recall campaigns, in general, are anticipated. Given the frequency of recalls during our sample period (especially for the Big Three), investors are sure to incorporate the likelihood of future recall campaigns into their estimates of firm value. Third, our estimate of the net loss to shareholders is based solely on recall campaigns covered in the *WSJ*. Approximately half of all recall campaigns have no associated article in the *WSJ*. Yet, these unpublicized campaigns may result in additional losses in shareholder value.

The cumulative losses for the six automakers total at least \$18.5 billion. This translates to a loss per vehicle of around \$132, on average, ranging from \$41 for GM to \$1,526 for Toyota.¹⁷ Though our estimate of \$132 (in 1990 dollars) is smaller than the estimate made by Jarrell and Peltzman (1985) of \$200 (in 1981 dollars), we have not adjusted our estimate on the basis of the anticipated probability of a recall campaign as Jarrell and Peltzman did.¹⁸

How much of the equity loss is due to reputation penalty rather than the direct cost of a recall? Though we do not have a reliable estimate of the direct costs of recall campaigns, we speculate, as Jarrell and Peltzman did, that the reputational penalty has been substantial. As argued above, \$132 is probably a substantial underestimate. Furthermore, the large estimates for Honda and Toyota, the automakers with a reputation for high-quality vehicles, indicate that when investors are confronted with news that betrays their expectations, they are ready to punish the companies without mercy.

B. Wealth Effects for Competitor Firms

We have established that the effect of recall campaigns for announcing firms is significant and negative. Next, we ascertain whether the

¹⁶ While expanding the event window would capture some of this anticipation, it also introduces noise into the analysis, and this noise leads to unreliable point estimates of mean abnormal returns.

¹⁷ The estimates for other automakers are \$273 for Chrysler, \$122 for Ford, \$501 for Honda, and \$57 for Nissan.

¹⁸ Jarrell and Peltzman's estimate is also based on a 2-week event window, whereas our estimate is based on a 2-day event window.

shareholder value of competitor firms is affected by the announcement of a recall campaign. For a given recall campaign, we estimate the 2-day CARs for an equally weighted portfolio of the announcing firm's competitors in two categories, domestic and foreign. Thus, for example, when a Chrysler recall campaign is covered in the *WSJ*, we calculate the 2-day CAR for (1) an equally weighted portfolio of Ford and GM and (2) an equally weighted portfolio of Honda, Nissan, and Toyota. In 20 cases, two U.S. companies announced a recall campaign on the same day. In these 20 cases, we consider the competitive response of the one U.S. nonrecall company. The results of this analysis (reported in Barber and Darrrough [1995]) reveal no significant response by competitor firms to the announcement of a particular automaker's recall campaign.

V. Conclusion

Our results resolve some ambiguity in the existing literature regarding the effect of recall campaigns and, by extension, product reliability on shareholder value. We document that when an automaker announces a recall campaign, on average, (1) the announcement redounds to the detriment of the shareholder value of the announcing firm, and (2) the announcement does not significantly affect the shareholder value of competitor firms. These results hold for both U.S. and Japanese automakers.¹⁹ The first result confirms the early conclusion of Jarrell and Peltzman (1985) that recall campaigns affect the shareholder value of announcing firms but contradicts the conclusions of Hoffer et al. (1988) that "little significant evidence remains indicating that securities markets penalize shareholders for an automotive recall by driving down share prices" (p. 669). On the other hand, the second result contradicts the early finding of Jarrell and Peltzman that recall campaigns have significant spillover effects for competitor firms, while confirming the conclusions of Hoffer et al. that shareholders of competitor firms are not significantly affected by the announcement of recall campaigns.

Interpreting vehicle recall experience as a measure of product reliability, we also document the vehicle reliability of six major automakers. Our results indicate that Japanese automakers have enjoyed a

¹⁹ We do not examine the impact of recall campaigns outside of the United States. It is possible that recall campaigns in Japan have a different impact on firm value than in the United States, since the business environment, safety standards, and the requirement for mandatory auto inspections are significantly different in Japan. We also limit the Japanese sample to the three automakers, which are the largest and had the longest presence in the United States. Of the Japanese motor vehicles sold in the United States, on average, 90 percent were made by these three automakers in the 1980s.

significant advantage over their American counterparts in terms of vehicle reliability. In addition, this advantage has not narrowed during the last decade (1983–92). Though there has been speculation lately in the media that the quality of American cars has improved relative to Japanese cars, we find no evidence that the Japanese advantage in terms of vehicle reliability has eroded during the latest decade of our sample (1983–92). Casual perusal of more recent data is not promising for American automakers. During 1993–95, the *WSJ* reported 15, 25, and 28 recalls for Chrysler, Ford, and GM, respectively, numbers that are not significantly different from those documented through 1992.

Our analysis has not considered the absolute level of quality or reliability. It is quite likely that all automakers are doing better, but the standards have gone up. Purchasers of vehicles, however, can observe many of the factors that characterize the quality of a vehicle (such as air bags, antilock brakes, etc.). What consumers cannot see is the integrity of the production process involved in the manufacture of vehicles and whether a vehicle is what it is supposed to be (and will be) at the time of purchase. Our analysis of the valuation consequences of recall campaigns indicates that these recall campaigns are viewed by the stock market as a credible (negative) signal regarding the integrity of the production process.

Our results indicate that, *ceteris paribus*, automakers can improve the welfare of their shareholders by improving product reliability. Product quality and reliability have been a major focus of manufacturing firms: total quality control, flexible manufacturing, just-in-time inventory control, activity-based costing, *kaizen* (continuous improvement), and lean production, among others, have been promoted and implemented as superior methods to improve manufacturing processes. How does one, however, prove that they are effective? There has been little evidence that directly links the quality improvement of motor vehicles to increased firm value. This paper documents such a direct link between product reliability and shareholder wealth. The stock market imposes a penalty on a manufacturer that produces defective vehicles. By improving product reliability, automakers can benefit both their shareholders and consumers.

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