

Online Appendix to "Product Recalls and Firm Reputation"

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March 16, 2020

A. Data and calculations

The recall data are from the National Highway Traffic Safety Administration (NHTSA) of the Department of Transportation. The website is

<https://www-odi.nhtsa.dot.gov/downloads/>

The data contain all NHTSA safety-related defects and compliance from late 1960s, and involve 1636 firms. For each recall they include the report-received date, record-creation date, a description of the recalled item such as model of the car, the name of the manufacture and date of manufacture. We construct the quarterly recall data as follows.

1. Removed the observations with missing recall report date, and/or start of manufacture date, and/or end of manufacture date, leaving a total of 48,014 cases; the Herfindahl index of the distribution of these firms' shares in the total number-of-recalls was 2.45%, and the 4-firm product-recall concentration ratio was 25.3%;
2. Sorted the cases by the report date, and created quarterly bins from 1966Q4 to 2012Q3;
3. Calculated the number of total recalls in each bin;

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4. Further removed bins with consecutive zero observations and ended up with a sample spanning 1978Q1 to 2007Q3; removed age ≥ 25 yrs because they contained outliers.
5. Took logs of the observations in each remaining bin and de-trended the series.

These are the data portrayed in the Figures in Sec. 3. The stock price starts to decline a few weeks before the recall date, but that is a small fraction of the mean time elapsed since start of manufacture, which is 4.14 years. Automobile manufacturers are required to correct a safety defect at no charge to the owner only for vehicles that are less than 10 years old – see <https://www-odi.nhtsa.dot.gov/recalls/recallprocess.cfm> Hence some of the observations on defects are less likely to show up in the recall data after 10 years.

B. Recalls and takeovers

In many cases the sale is to a private equity firm, and it is not known who will manage the company’s assets in the future. VC and buyout funds’ evidence is relevant to takeovers by private equity groups. Table A1 reports some examples from various sectors where recall was soon followed by an acquisition. Following the table are Figures ()-() which show the companies’ stock-price series around the time of the recall and subsequent takeover, with the exception of Bausch and Lomb which was privately owned.

Table A1: MAJOR RECALLS AND SUBSEQUENT TAKEOVERS

Firm	Recall date	Acquisition date	Acquirer
Takata ^a	Nov ‘14	Jun ‘17	Key Safety System ^g
Patties Foods ^b	Feb ‘15	Jun ‘16	Pacific Equity Partners
Bausch & Lomb ^c	Dec‘10/Nov‘12	Aug ‘13	Valeant Pharmaceut.
Cadbury/Schweppes ^d	Jun ‘06	Feb ‘10	Kraft
Merck ^e	Sep ‘04	Nov ‘09	Schering-Plough ^h
Keurig Green Mntn ^f	Dec ‘14	Dec ‘15	JAB Holding Co.

NOTES TO TABLE A1:

a) 65-70 million airbags (> 42 million vehicles) recalled for potential to deploy explosively, causing life-threatening injuries.

b) Thousands of frozen berries packets recalled after being linked to the Hepatitis A outbreak in Australia.

c) Approximately 150,000 contact lenses cleaner bottles recalled for not meeting sterility requirements. 2.5 million ophthalmic cannulas recalled for the potential to leak viscoelastic material or detach during injection, creating the potential for serious injury.

d) Over 1 million chocolate bars recalled due to a Salmonella outbreak.

e) Vioxx, a prescription arthritis drug, was taken off shelves after being linked to heart problems and causing thousands of deaths.

f) Approximately 7 million coffee makers recalled due to over-heating, causing burn-related injuries.

g) The Department of Transportation's recall schedule for vehicles containing Takata airbags grew increasingly aggressive from Nov. 2014 to Dec. 2016, as the product was continually linked to more and more fatalities. After facing an expected \$1 billion in fines by 2017, Takata declared bankruptcy in June 2017, and was then acquired by Key Safety Systems.

h) Merck acquired Schering-Plough. After a joint venture in 2000 to develop a cholesterol-lowering drug, many believed Merck and Schering-Plough would merge in the future. After the Sept. 2004 Vioxx recall, Merrill Lynch assessed an increase in the likelihood of Merck acquiring Schering-Plough, as it would be considered a "strategic action" taken to improve investor perception.¹ Nevertheless, no negotiations happened until Mar. 2009, when Merck decided to expand its laboratories via acquisition, due to increasing competition from generic drugs and years of declining sales. The merger was finalized in Nov. 2009, in which Merck bought Schering-Plough for \$41 billion. The deal was a reverse merger, in which Schering-Plough was the surviving company, but was renamed Merck.²

¹<https://www.forbes.com/2004/09/30/0930automarketscan09.html>

²<https://globalrecalls.oecd.org/front/index.html#/recalls?scrollTop=659>

but the only recalls the site has that are also listed in the above table are the Keurig recalls and the Takata recalls. However, for Takata, they only list a few of the vehicles recalled in Australia, and none from the U.S. The information is roughly the same as the one already in the table.

LINKS FOR NOTES TO TABLE A1:

- a) <https://www.consumerreports.org/car-recalls-defects/takata-airbag-recall-everything-you-need-to-know/>
- b) <https://www.reuters.com/article/pfl-ma-pep-idUSL4N18Q0PX>
- c) <https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfres/res.cfm?id=96528>
<https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfres/res.cfm?id=114567>
<https://www.bloomberg.com/news/articles/2013-05-27/valeant-agrees-to-buy-bausch-lomb-for-4-5-billion-cash>
- d) <https://www.theguardian.com/business/2006/aug/03/food.foodanddrink>
<http://news.bbc.co.uk/2/hi/business/8492572.stm>
- e) <https://www.reuters.com/article/us-merck-vioxx-settlement/merck-agrees-to-pay-4-85-billion-in-vioxx-settlement-idUSL0929726620071109>
- f) <https://www.nbcnews.com/business/consumer/keurig-recalling-nearly-7-million-coffee-makers-n273641>
<https://adage.com/article/cmo-strategy/keurig-acquired-jab-led-group-13-9-billion/301626>
- g) <https://www.crainsdetroit.com/article/20170626/news/632451/key-safety-systems-acquire-takata-159-billion-bankruptcy-deal>
- h) <https://www.reuters.com/article/us-merck-scheringplough/merck-schering-plough-set-to-complete-merger-idUSTRE5A23YZ20091103>



Figure A1: KEURIG STOCK PRICE HISTORY



Figure A2: MERCK STOCK PRICE HISTORY

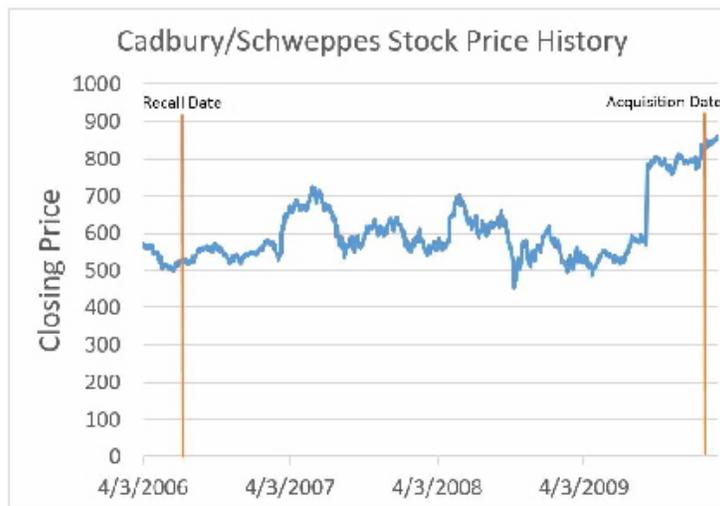


Figure A3: CADBURY/SCHWEPPE'S STOCK PRICE HISTORY



Figure A4: TAKATA STOCK PRICE HISTORY



Figure A5: PATTIES FOODS PRICE HISTORY

LINKS FOR FIGURES A1-A5:

Figure A1. <https://www.investing.com/equities/green-mountain-coffee-roasters-historical-data>

Figure A2: <https://finance.yahoo.com/quote/MRK/history?period1=1093996800period2=1264723200&interval=1d&filter=history&frequency=1d>

Figure A3. <http://www.tr4der.com/historical-prices/CBRY.L/>

Figure A4. <https://www.investing.com/equities/takata-corp-historical-data>

Figure A5. <https://au.investing.com/equities/patties-foods-historical-data>

C. Stock-price reaction to recalls – summary

Table A.2 reports value-loss multiple of recall costs (where costs are measured) as well as percentage abnormal returns (invariably negative). The latter are not directly usable, however because most firms have many products. As Jarrell and Peltzman note (p. 524) “A single product typically accounts for a smaller fraction of a firm’s profits the larger the firm.” Nevertheless, the relative differences in abnormal return estimates across studies should at least partially reflect differences in absolute value drops relative to direct costs across the samples studied by the various authors.

The first four rows deal with recalls of drugs and automobile-related products. The last two rows of Table A.2 summarize results dealing with financial misreporting and not recalls, but in the mechanism whereby they affect stock prices is similar. The analog of c is the sum of (upwards) misreported earnings plus the associated fines – an immediate subtraction from a company’s expected earnings.

Table A2: IMPACT ON STOCK PRICE

Authors	Value loss relative to costs	Abnormal stock-price % loss ^(g)
Jarrell & Peltzman (1985) ^(a)	Drugs: $12 \times$ recall costs	Autos: $<1\%$ pre 1975, $>2\%$ post 1975
Barber and Darrough (1996) ^(b)		0.32% for US, 0.69% for Japan
Rupp (2004) ^(c)	--	no significant effect
Hoffer, Pruitt and Reilly (1988) ^(d)	--	no significant effect
Armour, Meyer and Polo (2017) ^(e)	$9 \times$ fines	
Karpoff (2012) ^(f)	$3 \times$ (fines + misreported earnings)	

NOTES TO TABLE A2:

(a) Drugs recalls during 1974-1982. Fines were imposed in a significant fraction of the drug cases in which case the factor of 12 is an overestimate of reputational losses because stock price reduction would partly be explained by the subtraction of fines from the company’s earnings. The authors also studied the abnormal stock-price returns effects of 116 auto recalls during 1967-1981 but did not have estimates of direct costs.

(b) For the U.S. their data covered 573 recalls during the 1973-92 period.

(c) 592 automobile recalls between 1973-98, looked at both the # of vehicles repaired and the # recalled.

(d) U.S. automobile recalls between 1975-1981.

(e) 40 financial misconduct cases in U.K. during 2001-2011. These data are especially useful because “In the U.K., the entire enforcement process involves only one public announcement and is accompanied by complete information on legal penalties.” (Abstract)

(f) Surveys evidence on effects of fines for financial misconduct. A part of the value drop is the misreporting correction; companies were fined because they had misreported their earnings. Reputation accounts for $100 - 24 - 9 = 67$ percent of the value drop.

(g) Not used to constrain the estimates because the recalled product is generally one of several that a company sells. The percentage loss of future earnings would be a larger fraction of the earnings that the company derives from the product in question.

D. Recall-related fines and accompanying subsidies

The FDA archive at <https://www.fda.gov/Safety/Recalls/ArchiveRecalls/default.htm> contains specific details on firms/products fined.

Table A3 : RECALL-RELATED FINES

Firm	Product	Recall Date	Recall Cost	Fine	FineDate	Imposer
Advanced Bionics LLC ¹	Hearing Aids	2004, 2006 2010	\$61 mill. sales lost & \$46 mill. operating loss in 2010 ^A \$7.25 mill. awarded in 2013 to injured consumer ^B	\$1.1 mill. civil penalty ^C	03/08	FDA
Jarden Consumer Solutions ²	Coffee Makers	08/12	Recalled 520,000 in U.S., 87,000 in Can. each sold for \$60-\$80	\$4.5 mill. civil penalty ^D	06/16	FDA
Dr. Reddy's Laboratories ³	Prescrptn Drugs	2014-2017		\$5 mill. civil penalty ^E	01/18	Fed. Crt in NJ
Merck ⁴	Vioxx Painkiller	09/04	paid \$4.85 bill. to settle lawsuits; took product off shelves- had annual sale of \$2.5 bill. ^F	\$321 mill. criminal fine \$426 mill. to Fed. Govt. \$202 mill. to state Medicaid agencies \$949 mill. total ^G	11/11	FDA

NOTES ON TABLE A3:

1) Due to manufacturing violations, the hearing aids put patients at risk of device failure and additional hearing loss. Boston Scientific purchased Advanced Bionics in 2004, prior to recall, for \$28.4 billion. Embarrassed

by the FDA violations and disagreements regarding how much to spend on quality control (Boston Scientific wanted to spend more), they undid the merger in 2007^H. The FDA sought a \$2.2 million fine but they eventually settled for \$1.1 million. Advanced Bionics was eventually acquired by Sonova in 2009 and following the 2010 recall, the share price for Sonova fell by 7.25%.^I

2) Several consumers suffered burn injuries from the coffee makers. Jarden failed to report product defects to the U.S. Consumer Product Safety Commission (CPSC) immediately. In April of 2016, Newell Rubbermaid acquired Jarden for \$15.4 billion.^J

3) Packaging of the products was not child resistant and Dr. Reddy's Labs failed to immediately report the problem to the CPSC. Following the announcement of the \$5 million fine on Dr. Reddy's Labs., the stock price in India fell by 1.89%^K

4) Vioxx was illegally marketed as a treatment for rheumatoid arthritis before it was officially approved as such by the FDA. The drug also substantially increased the risk of cardiovascular problems. Merck merged with Schering-Plough in November of 2009 for \$41 billion. Following the recall, Merck suffered a drop in stock price – See Fig.

LINKS IN TABLE A3:

A <https://www.wsj.com/articles/SB10001424052748704369304575632283068839288>

B <https://www.usatoday.com/story/news/nation/2013/04/18/cochlear-implant-case-award/2094397/>

C <https://www.aboutlawsuits.com/cochlear-implant-recall-advanced-bionics-14506/>

D <https://www.cpsc.gov/content/jarden-consumer-solutions-agrees-to-pay-45-million-civil-penalty-for-failure-to-report>

E <https://www.justice.gov/opa/pr/district-court-awards-5-million-civil-penalties-and-enters-permanent-injunction-prevent-dr>

F <https://www.reuters.com/article/us-merck-vioxx-settlement/merck-agrees-to-pay-4-85-billion-in-vioxx-settlement-idUSL0929726620071109>

G <https://www.nytimes.com/2011/11/23/business/merck-agrees-to-pay-950-million-in-vioxx-case.html>

H <https://www.wsj.com/articles/SB118669347808193458>

I <https://www.wsj.com/articles/SB10001424052748704369304575632283068839288>

J <https://www.bloomberg.com/news/articles/2015-12-14/newell-rubbermaid-to-buy-jarden-for-13-2-billion-adding-brands>

K www.business-standard.com/article/news-cm/dr-reddy-s-drops-as-us-agency-charges-firm-for-packaging-lapses-116060900226_1.html

Although not a fine directly for the recalls, Japan's Ministry of Transport has sought fines for poor inspection practices which led to the recalls at firms such as Suzuki, Nissan, and Subaru.³

Regarding the offsetting flow subsidy S , it appears that several countries do subsidize automobile production (and, in recent years, especially for fuel-efficient vehicles):

<http://theconversation.com/factcheck-do-other-countries-subsidise-their-car-industry-more-than-we-do-16308>,

<https://www.wsj.com/articles/SB10001424052970203918304577242461777082458>.

E. *Illustrative examples of $\mu(t)$*

The following three illustrative examples of f s for which μ has a simple solution

(i) *Uniform* $[0, 1]$, i.e., $F(t) = t$. Then $\mu(t) = 2(1 - t)$, and its mean is unity, i.e., twice that of f

(ii) *Exponential*, i.e.,

$$F(t) = 1 - e^{-at}, \mu(t) = ae^{-at} = f(t) \quad (1)$$

i.e., it is also exponential and has the same density, and the same mean. We shall come back to this example shortly.

(iii) *Pareto*, i.e., $F(t) = 1 - t^{-\alpha}$ for $t \geq 1$ and $\alpha > 1$. Then $\mu(t) = (\alpha - 1)t^{-\alpha}$ is also Pareto but with a coefficient $\alpha - 1$, so that its mean, $(\alpha - 1)/(\alpha - 2)$, exists only if $\alpha > 2$. and is greater than that of f .

These solved examples involve different F distributions from the one that model implies – they are for illustrative purposes only.

³<https://www.japantimes.co.jp/news/2019/06/07/business/corporate-business/transport-ministry-seeks-fine-suzuki-motor-inspection-scandal/#.XS39jfZFy3A>

F. List of symbols

LIST OF SYMBOLS		
SYMBOL	DEFINITION	1ST USE IN EQ. #
$F(t), f(t)$	inter-recall wait time CDF & pdf	(4)
$\mu(t)$	product age pdf	(9)
w	value loss relative to k	(33)
$t(x)$	inverse of the function x_t	(34)
$\zeta(w)$	pdf of w	(34)
$B(t), b(t)$	unconditional wait-time CDF and pdf	(35), (36)
$G(x)$	CDF of x	(38)
l	value loss relative to v	(44)
$L(l)$	CDF of l	(45)