



October 2018

Analysis of Market's Reaction to Plea Agreements

Use of Event Studies in Detecting Abnormal Stock Returns

Event studies are commonly used to analyze how specific events impact stock returns. Events of interest can include mergers and acquisitions, earnings or dividend announcements, litigation, government investigations, or company scandals.¹

Fama, Fisher, Jensen, and Roll (1969)² was one of the first papers that utilized event studies in analyzing stock splits. Since then, event studies have been used in thousands of papers, including those that analyze how stock prices can be impacted by events related to litigation.³

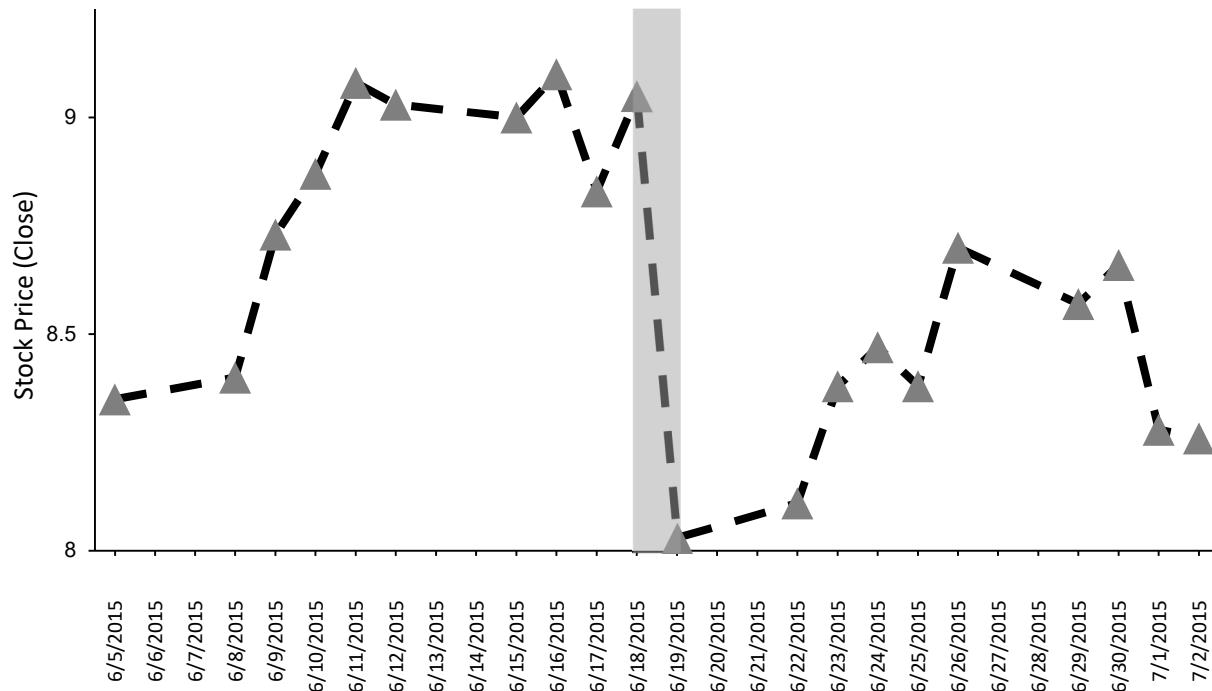
Discovery of Corporate Illegality

Stock markets generally react negatively to news of corporate illegality.⁴ Braskem S.A.'s bribery and corruption scandal is an example. Marcelo Odebrecht, the then-chairman of Braskem S.A.,⁵ was arrested on June 19, 2015 as part of a major corruption investigation in Brazil.⁶ Braskem's stock price declined about 11% the day of Marcelo Odebrecht's arrest. **Figure 1: Braskem (BAK.NYSE) Stock Prices (in USD) Before and After Odebrecht's Arrest** shows Braskem's stock prices before and after Odebrecht's arrest.

Volkswagen's emissions scandal is another example. The U.S. Environmental Protection Agency ("EPA") issued Volkswagen a notice of violation of the Clean Air Act on September 18, 2015. Once the issuance of the EPA notice became known to the public, Volkswagen's stock price tumbled by over 30% within a week.⁷

A third example is Facebook's data hijacking scandal. Millions of Facebook profiles were shared with Cambridge Analytica, which allegedly used the data to build software to influence voters. The scandal became widely known to the public through March 17, 2018 reports in the *Guardian* and the *New York Times*.⁸ Facebook's stock price dropped by more than 5% in early morning trading on the next Monday. Subsequently, a Federal Trade Commission investigation began on March 20, 2018, which sent Facebook's stock price even lower.⁹

Figure 1: Braskem (BAK.NYSE) Stock Prices (in USD) Before and After Odebrecht's Arrest



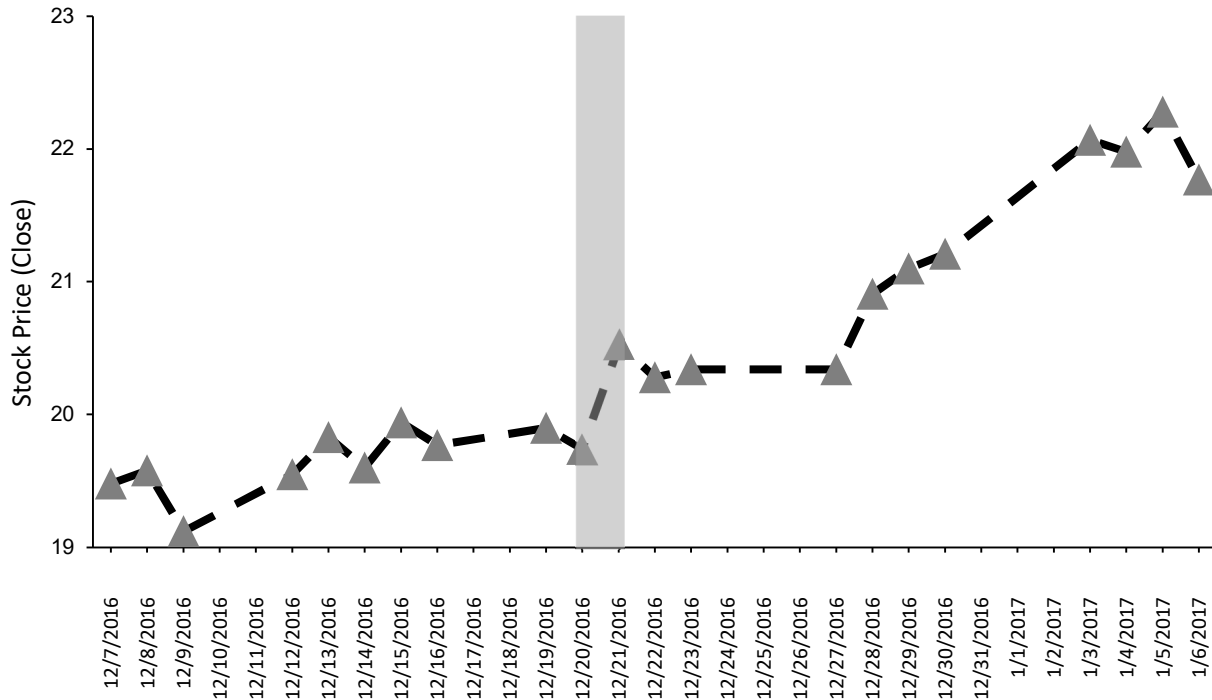
Plea Agreement Announcements

On the other hand, stock markets generally react positively to the conclusion of federal corporate prosecution, because it removes uncertainty surrounding pending litigation, improves the reputation of a firm, prevents appeals and follow-up suits, and reduces potential future costs related to litigation.¹⁰

For example, investigations into Braskem S.A. continued after the arrest of Marcelo Odebrecht until December 21, 2016, when the U.S. Department of Justice (“DOJ”) announced it had reached an agreement with Braskem in which Braskem would plead guilty and pay a penalty of \$632 million.¹¹ Its stock price subsequently rose after the announcement of the plea agreement, as investors welcomed the resolution. **Figure 2: Braskem (BAK.NYSE) Stock Prices (in USD) Before and After DOJ Announcement of Braskem Guilty Plea** shows Braskem’s stock prices before and after this announcement.

Similarly, the DOJ brought suit against Volkswagen for cheating on diesel emissions tests, lying, and obstructing justice. The DOJ announced that Volkswagen would plead guilty on January 11, 2017.¹² Its stock price also rose after the announcement of the plea agreement.¹³

Figure 2: Braskem (BAK.NYSE) Stock Prices (in USD) Before and After DOJ Announcement of Braskem Guilty Plea



Empirical Analysis of Plea Agreement Announcements

We conducted an event study to evaluate the impact of criminal plea agreement announcements on the stock returns of companies. To identify affected companies, we used a database that contains information relating to federal criminal cases brought against organizations, including companies traded on U.S. stock exchanges. The event of interest in our study is the announcement of a company agreeing to a plea deal in connection with charges brought by the U.S. Department of Justice.

Data Collection

We used the Corporate Prosecution Registry (the “Registry”),¹⁴ which is a joint project of the Legal Data Lab at the University of Virginia School of Law and Duke University School of Law. It aims to provide comprehensive and up-to-date information on every federal organizational prosecution in the United States since 2001. The information in the Registry was collected from Public Access to Court Electronic Records (“PACER”), an electronic public access service that allows the public to access case and docket information from federal courts, as well as the Department of Justice website.

The Registry includes information on whether plea agreements were entered into by federal prosecutors and whether the defendant was a publicly-traded company in the U.S. for each criminal case in the database. In addition, the Registry contains information about settlement payments made by affected organizations, any fines assessed, and other payments made or punishments levied. Finally, the Registry includes information for the date of the plea. We used the Registry to identify those companies that entered into a plea agreement with federal prosecutors between January 1, 2008 and September 4, 2018, the date we queried the database (the “Relevant Time Period”).

Because stock prices for privately-held companies are generally unavailable, we restricted the analysis to companies that are traded on NYSE or NASDAQ. We filtered out those companies that were not designated by the Registry as a “U.S. public company.” We verified whether these companies were indeed traded on U.S. stock exchanges utilizing a Yahoo Finance database.¹⁵ After these filters were applied, the database (the “Initial Database”) reflected plea agreements entered into during the Relevant Time Period by companies traded on U.S. stock exchanges. We refer to each of the plea agreements as a “Plea Event.” There are 58 Plea Events from 51 companies in the Initial Database. We removed seven Plea Events that were associated with large financial institutions from the Initial Database, as these firms have been involved in large amounts of litigation after the financial crisis.

Stock prices typically react to news or the announcement of an event prior to the event occurring. Such an impact is referred to as an announcement effect. To correctly evaluate the relationship between the plea agreements and stock prices, it is important to identify the dates when the plea agreements were announced. For each Plea Event in the Initial Database, we searched the DOJ website¹⁶ for a press release announcing the plea agreement between the company and the DOJ. Because the DOJ did not publish a press release regarding every plea agreement in the Initial Database, we revised the database to include only those Plea Events with an associated plea agreement press release available from the DOJ website, as it is difficult to identify the first instance of public knowledge of these plea agreements. This gave us 43 Plea Events from 39 companies (the “Database”).

We downloaded stock price data relating to each Plea Event in the Database from Yahoo Finance and Alpha Vantage, a website that collects and publishes financial data relating to U.S. companies.¹⁷ Specifically, we downloaded stock price data for the affected companies one year preceding and one year following the announcement of a Plea Event, which we defined as the earlier of (1) the DOJ press release, or (2) the date the plea agreement was filed, as reflected in the Registry (the “Event Date”).

We also downloaded performance data for the S&P 500 stock market index from January 1, 2007 to September 5, 2018 from Yahoo Finance. We used the S&P 500 stock market index as the market benchmark in the analysis. The use of a common market index as the market benchmark is standard in event studies, including studies that analyze companies across multiple sectors.¹⁸

Event Studies

We followed a standard event study approach to analyze whether the stock returns of a company displayed any abnormal behavior on or around the Event Date.¹⁹ The approach uses daily stock prices of a company and a market index from before and after the Plea Event.

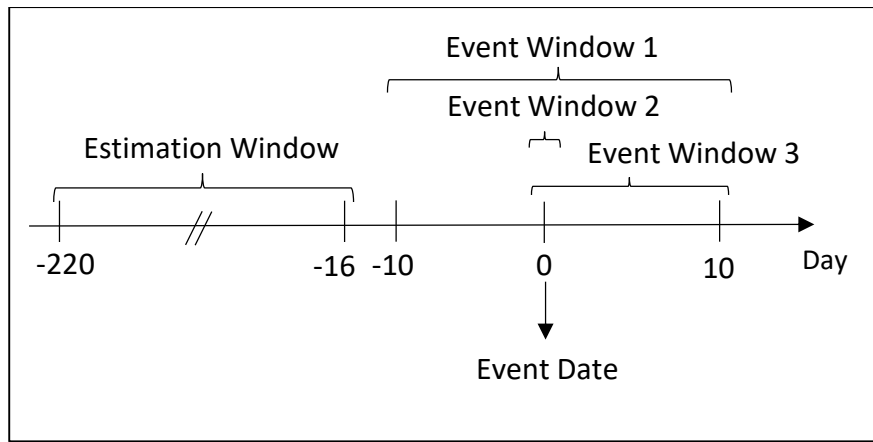
It is important to incorporate a market index into an event study. Doing so helps the researcher accurately identify the reason for a change in the stock price. If, for example, it was observed that a company’s stock returns went down during the time frame, such a change could be because the market reacted to the event negatively, but it could also be because the broader market went down for other reasons. In order to isolate the impact of the event, it is important to identify the changes in stock returns due to the average market effect.

We conducted an event study as follows for the 43 Plea Events.

First, we identified three important dates and periods. The first is the Event Date, which is the earlier of (1) the DOJ press release, or (2) the date the plea agreement was filed, as reflected in the Registry. The

second is the estimation window, which includes the time period starting 220 market days prior to the Event Date and ending 16 market days prior to the Event Date.²⁰ As described below, we utilized data in this window to estimate how the company’s stock returns are typically correlated with the market index. The third is the event window, during which we tested for abnormal returns. We modified all the dates in our database to be relative to the Event Date. Specifically, the Event Date was Day 0, the day before the Event Date was Day -1, and the day after the Event Date was Day 1, etc. We utilized three event windows, one from 10 days before the Event Date to 10 days after the Event Date, one only on the Event Date, and one from the Event Date to 10 days after the Event Date. These three event windows are illustrated in **Figure 3: Example Selection of Important Dates in the Event Study**.

Figure 3: Example Selection of Important Dates in the Event Study



Second, we predicted the relevant company’s expected stock returns during the event window. Expected returns are the returns that one would expect in the absence of noteworthy events. To do so, using data from the estimation window, we implemented a market model that assessed the correlation between the stock returns of the relevant company and the overall returns of the stock market (the S&P 500).²¹ This correlation is often defined as the market beta. We then used this market beta and market return data during the event window to predict how the company’s stock would have normally behaved during the event window, that is, how the stock would have behaved in the absence of the event itself.

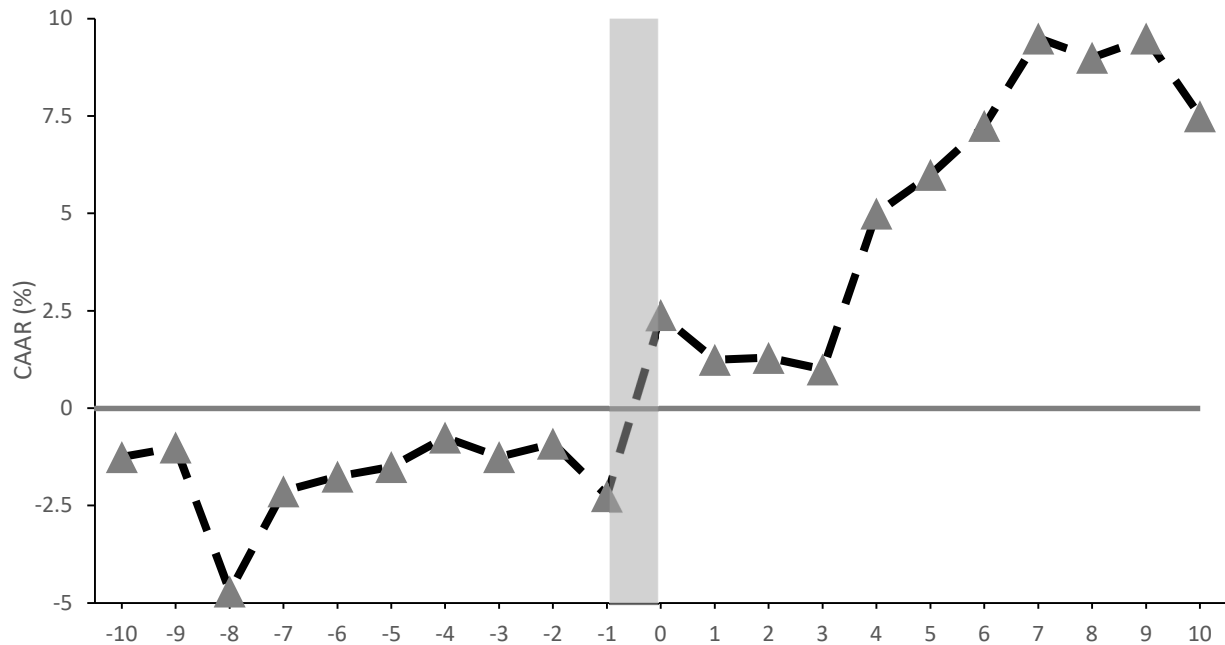
Third, we calculated the abnormal returns. To do so, we compared the predicted normal returns of the company’s stock, estimated as described above, with the actual stock returns in the event window. This gave us the forecast error, which we refer to as the stock’s abnormal returns. Because it is impossible to forecast stock returns perfectly, abnormal returns are typically non-zero on any given day in the event window, but when aggregated, they should be close to zero in the absence of plea agreements. The goal of the analysis is to evaluate whether announcements of plea agreements were associated with abnormal returns that were outside of normal ranges.

For each of the 43 Plea Events (affecting 39 firms), we conducted event studies for three different event windows: Day -10 to Day 10, Day 0 to Day 0 (during the date of the Plea Event), and Day 0 to Day 10.

For each event window for each Plea Event, we summed the abnormal returns during the event window to determine the cumulative abnormal returns (the “CAR”) for each Plea Event.

Braskem S.A. was one of the companies in our sample. Its stock price increased immediately after the announcement of the event. Overall, the CAR was equal to 6.97% during this 21-day event window. Their CAR is shown in **Figure 4: CAR of Braskem During the Event Window From Day -10 to Day 10**.

Figure 4: CAR of Braskem During the Event Window From Day -10 to Day 10



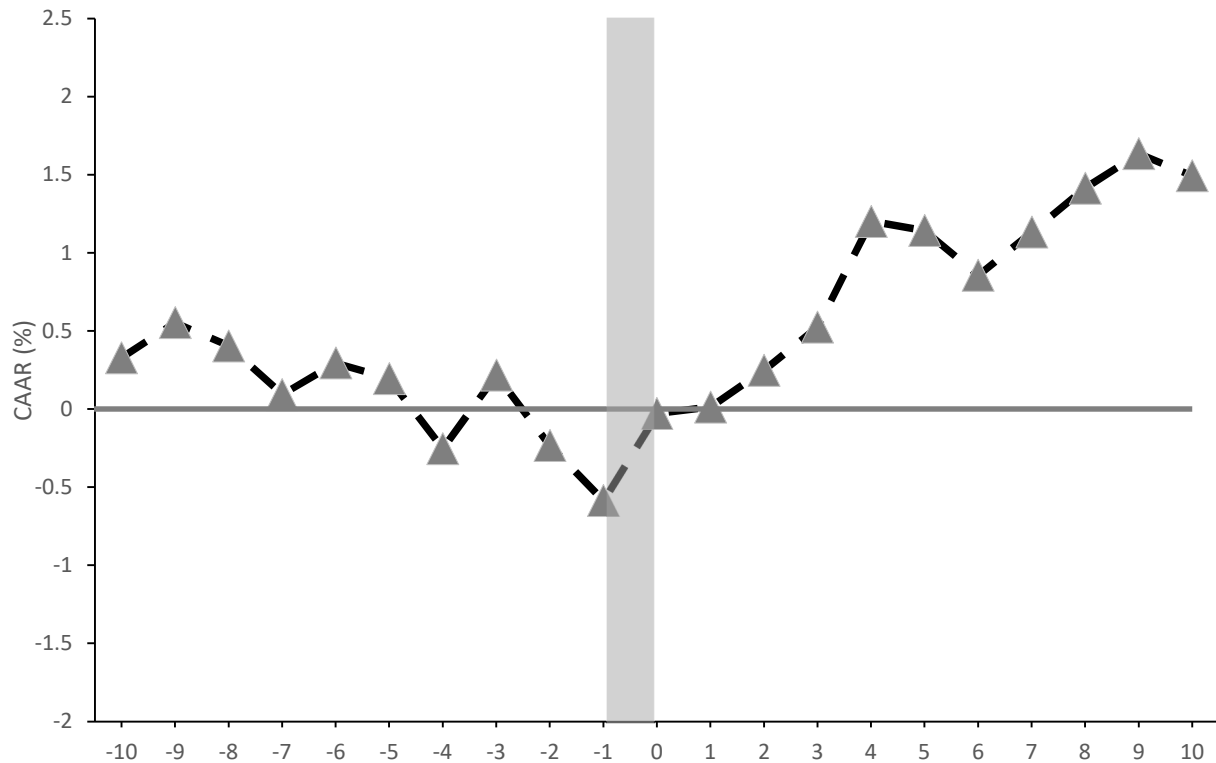
We next aggregated the CAR across all Plea Events in the Database by calculating the average CAR values for all Plea Events (the “CAAR”). Aggregating the results allowed us to draw overall inferences regarding the effect of plea agreements.²² The closer the CAAR is to zero, the less the impact a Plea Event had on a stock’s returns.

To draw these inferences, we used a parametric one-sided t-test. We tested whether the CAAR was less than or equal to zero (the “Null Hypothesis”) during the event window. The t-test generated a p-value, the greatest probability level for which the t-test fails to reject the Null Hypothesis. Therefore, it is more likely the Null Hypothesis is true when the p-value is higher.

Model Results & Conclusion

As demonstrated in **Figure 5: CAAR During the Event Window From Day -10 to Day 10**, for the event window that goes from Day -10 to Day 10, the CAAR prior to the Event Date was very close to zero, but after the Event Date the CAAR started rising and eventually plateaued. The CAAR was 1.5% during this 21-day event window.

Figure 5: CAAR During the Event Window From Day -10 to Day 10



However, even though the CAAR was positive in this event window, the t-test indicated that it is not statistically significant at the 95% confidence level.

For the other two event windows, which both start from the Event Date, the CAAR is greater than zero, and the p-value of the t-tests indicate that it is statistically significant (at the 95% confidence level). We reject the null hypothesis that stock returns decline or remain the same after a plea deal announcement. **Table 1: Model Results** reports the CAAR for each of the event windows, the p-value, and whether the CAAR was positive and significant at the 95% confidence level.

Table 1: Model Results

Event Window	CAAR	p-value	Significantly Positive?
Day -10 to Day 10	1.49%	15.09%	No
Day 0 to Day 0	0.56%	3.28%	Yes
Day 0 to Day 10	2.08%	2.15%	Yes

For any additional inquiries, please contact info@vegaeconomics.com.

¹ Campbell, John Y., Andrew W. Lo, and A. Craig MacKinlay. "Event-Study Analysis." *The Econometrics of Financial Markets*. Princeton: Princeton University Press (1997): 149-180 at 149.

² Fama, Eugene F., Lawrence Fisher, Michael C. Jensen, and Richard Roll. "The Adjustment of Stock Prices to New Information." *International Economic Review* 10.1 (1969): 1-21.

³ See Bhagat, Sanjai, John Bizjak, and Jeffrey L. Coles. "The Shareholder Wealth Implications of Corporate Lawsuits." *Financial Management* 27.4 (1998): 5-27 (which reviews academic research on litigation in corporate finance, including stocks' reactions to lawsuit announcements).

⁴ See, e.g., Davidson III, Wallace N. and Dan L. Worrell. "The Impact of Announcements of Corporate Illegalsities on Shareholder Returns." *Academy of Management Journal* 31.1 (1988): 195-200 at 198.

⁵ "Marcelo Odebrecht Formally Resigns from Odebrecht S.A." *Odebrecht Press Release* (Dec. 10, 2015). <<https://www.odebrecht.com/en/communication/releases/marcelo-odebrecht-formally-resigns-odebrecht-sa>> (accessed Oct. 10, 2018).

⁶ Stauffer, Caroline and Walter Brandimarte. "Update 7-Powerful Brazil CEO Arrested in Petrobras Graft Probe." *Reuters* (June 19, 2015). <<https://www.reuters.com/article/brazil-petrobras-scandal-idUSL1N0Z50JB20150619?>> (accessed Oct. 9, 2018); Horch, Dan. "Brazil Arrests Head of Odebrecht in Petrobras Scandal." *The New York Times* (June 19, 2015). <<https://www.nytimes.com/2015/06/20/business/international/brazil-arrests-head-ofodebrecht-in-petrobras-scandal.html>> (accessed Oct. 9, 2018).

⁷ Snyder, Benjamin and Stacy Jones. "Here's a Timeline of Volkswagen's Tanking Stock Price." *Fortune* (Sept. 23, 2015). <<http://fortune.com/2015/09/23/volkswagen-stock-drop/>> (accessed Oct. 9, 2018).

⁸ For original reporting of the scandal, see Rosenberg, Matthew, Nicholas Confessore, and Carole Cadwalladr. "How Trump Consultants Exploited the Facebook Data of Millions." *The New York Times* (Mar. 17, 2018).

<<https://www.nytimes.com/2018/03/17/us/politics/cambridge-analytica-trump-campaign.html>> (accessed Sept. 4, 2018); and Cadwalladr, Carole and Emma Graham-Harrison. "Revealed: 50 Million Facebook Profiles Harvested for Cambridge Analytica in Major Data Breach." *The Guardian* (Mar. 17, 2018).

<<https://www.theguardian.com/news/2018/mar/17/cambridge-analytica-facebook-influence-us-election>> (accessed Sept. 4, 2018).

⁹ See McLaughlin, David, Ben Brody, and Billy House. "Facebook Draws Scrutiny from FTC, Congressional Committees." *Bloomberg Politics* (Mar. 20, 2018). <<https://www.bloomberg.com/news/articles/2018-03-20/ftc-said-to-be-probing-facebook-for-use-of-personal-data?>> (accessed Sept. 4, 2018).

¹⁰ Flore, Christian, Sascha Kolaric, and Dirk Schiereck. "Settlement Agreement Types of Federal Corporate Prosecution in the U.S. and Their Impact on Shareholder Wealth." *Journal of Business Research* 76 (2017): 145-158.

¹¹ United States Department of Justice Office of Public Affairs. "Odebrecht and Braskem Plead Guilty and Agree to Pay at Least \$3.5 Billion in Global Penalties to Resolve Largest Foreign Bribery Case in History." *Justice News* (Dec. 21, 2016). <<https://www.justice.gov/opa/pr/odebrecht-and-braskem-plead-guilty-and-agree-pay-least-35-billion-global-penalties-resolve>> (accessed Oct. 9, 2018).

¹² United States Department of Justice Office of Public Affairs. "Volkswagen AG Agrees to Plead Guilty and Pay \$4.3 Billion in Criminal and Civil Penalties; Six Volkswagen Executives and Employees are Indicted in Connection with Conspiracy to Cheat U.S. Emissions Tests." *Justice News* (Jan. 11, 2017). <<https://www.justice.gov/opa/pr/volkswagen-ag-agrees-plead-guilty-and-pay-43-billion-criminal-and-civil-penalties-six>> (accessed Sept. 4, 2018).

¹³ Reuters. "VW Shares Are Popping on News of \$4.3 Billion Emissions Settlement Deal." *Fortune* (Jan. 11, 2017). <<http://fortune.com/2017/01/11/volkswagen-shares-emissions-settlement-deal>> (accessed Sept. 4, 2018).

¹⁴ Garrett, Brandon L. and Jon Ashley. *Corporate Prosecution Registry, Duke University and University of Virginia School of Law*. <<http://lib.law.virginia.edu/Garrett/corporate-prosecution-registry/index.html>> (accessed Sept. 4, 2018).

¹⁵ Yahoo Finance. <<https://finance.yahoo.com/>> (accessed Sept. 4, 2018).

¹⁶ United States Department of Justice Office of Public Affairs. *Justice News*. <<https://www.justice.gov/news>> (accessed Sept. 4, 2018).

¹⁷ Alpha Vantage. <<https://www.alphavantage.co>> (accessed Sept. 4, 2018).

¹⁸ See Thompson, Joel E. "More Methods That Make Little Difference in Event Studies." *Journal of Business Finance & Accounting* 15.1 (1988): 77-85.

¹⁹ Campbell, Lo & MacKinlay, *supra* note 1, at 150-152.

²⁰ This choice of estimation window is common in the academic literature. See, e.g., Koku, Paul Sergius and Anique A. Qureshi. "Analysis of the Effects of Settlement of Interfirm Lawsuits." *Managerial and Decision Economics* 27.4 (2006): 307-318 at 314.

²¹ Although using a common market index is standard in event studies, we implemented alternative market benchmarks that control for industries, relative market cap, and book-to-market ratios, among others, and the model results are similar across all benchmarks we implemented.

²² See Campbell, Lo & MacInlay, *supra* note 1, at 160.