

Public and private sanctions: the case of cartels

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Abstract

In this article, we revive an old debate in the law and economics literature: the relative role of public and private (market-based) sanctions in deterring misconduct. We harness recent developments in opinion mining to offer a novel framework, which accounts for public sanctions and a more direct measure of private sanctions. We propose using the intensity and the sentiment of media exposure of misconduct as a measure of reputational effect and thus an approximation of the private sanction. As a demonstration, we combine event study techniques, sentiment analysis, and classic econometrics on a sample of 339 listed companies belonging to 150 cartels prosecuted by the European Commission between 1992 and 2015. Our main finding is that in the context of cartels, public and private sanctions act as complements, but only if the cartel directly affects atomistic customers. In other cartels, we found no consistent relationship between public and our measure of private sanctions.

Key words: Cartels, event study analysis, private sanctions, public sanctions, sentiment analysis.

JEL Classification: L4, K4.

1. INTRODUCTION

Most illegal behaviours face two types of sanctions: a public sanction, imposed directly by an administrative body or the court; and a market-based one (private sanction), which materialises indirectly through market mechanisms. The law and economics literature that studies private and public sanctions seems to agree that private sanctions can deter corporate misbehaviour, inasmuch as the offenders internalise the social cost of the offences; and concurs on the point that public sanctions are needed when the harm caused by the offence is not internalised.

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An important upshot of previous literature is that private (reputational) sanctions tend to work in contractual relationships, particularly, in repeated purchase settings.¹ Klein and Leffler (1981), Shapiro (1983), and Lott Jr (1988) provide theoretical models where customers of a business change their custom in response to a breach in the contractual agreement (related-party offence).² The credibility of the reputational sanction derives from the change in purchasing patterns that accompanies a change in beliefs about the offence. In this case, some, or all costs of the damages caused by the misbehaviour can be internalised by the offending firm through its repeated contracting with customers, suppliers, employees, and investors.³ Private sanctions are sufficient where the only damaged party is a customer of the unlawful business and the total amount of the damages are internalised by the offender. In this setting, public sanctions are only required to the extent the private sanction does not encompass the total social cost of the offence.

Empirically, Peltzman (1981), Karpoff and Lott Jr (1993), Alexander (1999), Karpoff et al. (2008) studied how markets react to fraudulent or misleading behaviour. Jarrell and Peltzman (1985) and Mitchell and Maloney (1989) examined the reputational impact of product recalls (faulty products). Both of these behaviours are related-party conducts. Jones and Rubin (2001) and Karpoff et al. (2005) looked at environmental violations (a third-party offence). Their findings are in line with the theory: private sanctions are effective mostly in related-party offences, and only public sanctions are powerful in third-party offences. Armour et al. (2017) provide further empirical evidence to this distinction.

One of the key difficulties in these previous empirical works is that too often private sanctions (and largely their determinants) are difficult to directly observe and measure, and this complicates the empirical evaluation of their effectiveness. To overcome this, previous works have linked private sanctions to the reputational effect of companies, and used an indirect measure of this reputational impact by decomposing the share price effect of various corporate wrongdoings into: the effect of the public sanction, a readjustment effect (without the wrongdoing profits are expected to be lower), and a residual which can be associated to reputational loss.⁴ This is driven by the intuition that reputation is an intangible asset, the value of which is expressed as a component of the share price valuation of the business. In this setting reputational loss is manifested by a stock price drop

¹In this paper we use the terms private and reputational sanction interchangeably.

²Literature distinguishes between ‘related-party’ and ‘third-party’ crimes to refer to behaviour that affects contractual parties (for example some types of fraud, as in Karpoff and Lott Jr (1993)) and behaviour that impacts third parties (for example environmental violations, as in Karpoff et al. (2005)).

³In third party-offences, the damage caused by the offence is not internalised through a reputational punishment by third-parties.

⁴See for example: Peltzman (1981), Karpoff and Lott Jr (1993), Alexander (1999), Karpoff et al. (2008)

because the share price valuation reflects investors' expectations of loss in future profits at lower levels of reputation. This might entail expectations that future sales will drop, or that firms will have to spend on correcting measures (extra advertising or price drops) to mitigate the reputational loss.

We provide an important methodological contribution by offering a more direct way to measure determinants of the magnitude of the reputational effect. Recent developments in opinion mining and natural language processing allow us to extract the opinion in the media coverage of corporate offences, and to study the relationship between share price valuation and opinion ([Van de Kauter et al. \(2015\)](#)). To the best of our knowledge, no such analysis has been conducted to investigate the effectiveness of private sanctions on firms' behaviour. The context of illegal cartels gives us an ideal ground to test this framework. When the regulator discovers a cartel, this information is not automatically distributed to all related parties (especially not to atomistic consumers). Various information channels are in action to pass the news on the cartel conduct to the public. We offer a way to measure the sentiment and the spread of this information, and because without this information there would be no reputational impact, we posit that the sentiment and the intensity of the information is directly proportional to the reputational effect.

Our proposal offers a workable, and easy-to-implement framework for studying private and public sanctions. The public sanctions are directly obtained from administrative and court decisions and private sanctions are approximated by a reputational effect, which we measure through the intensity and the sentiment of media exposure of the misconduct. We estimate the effect of these measures on the market valuation of offending firms. One of the main advantages of this framework is that data on media exposure is easily available from public sources. To demonstrate this, we use a publicly available dataset on EU cartels assembled by the European Commission (Commission), which we merge with a database on news articles that document and describe the illegal cartel (and cartel members) behaviour. We do a count of news sources per cartel member as indicator of exposure of each cartel member to the news, and then quantify the opinion of each news' item using sentiment analysis. Loss or gain in market valuation is used as a proxy for the deterrence power of these two types of sanctions.

Our empirical strategy gives us an opportunity to look at the relative role of public and private sanctions in deterring misconduct. Based on the premise that businesses are averse to falling market valuation, we assume that sanctions with larger negative effect on valuation act as stronger deterrent. We then estimate the relative effect of public and private sanctions on firms' market valuation. If the

two are substitutes, lower public sanctions will not result in lowered valuation if private sanctions increase at the same time. This follows the same logic as [Karpoff and Lott Jr \(1993\)](#). On the other hand, there is also a possibility that public and private sanctions act as complements. [Iacobucci \(2014\)](#) provides a theoretical framework to demonstrate that the size of the public sanction affects the size of the private sanction and larger fines are associated with larger reputational punishment. This is intuitive, as public attitude is likely to be influenced by news on the magnitude of sanction, which is perceived as directly proportional to the seriousness of the offence. In our framework, complementarity would mean that increasing public sanctions only drives down market valuation if at the same time private sanctions also increase.

2. EUROPEAN CARTELS - INSTITUTIONAL SETTING

We use cartels detected by the European Commission as illustration of our proposed framework. To give a brief institutional introduction, in the European Union, the principal body in charge of investigating cartels is the European Commission (at national level the member state competition authorities enforce anti-cartel laws). The investigation can start following: (a) a complaint, (b) the opening of an own-initiative investigation, or (c) a leniency application from one of the participants to a cartel. Following an initial investigative phase, the Commission decides whether to conduct an in-depth investigation - which typically starts with a dawn raid of the suspected cartel members' offices. This is the first point at which the fact of the investigation is publically announced. However, there is some possibility that investors anticipate the investigation even before this date. It is not uncommon that a US cartel investigation is followed by an investigation in the EU. Once the Commission reached its decision, it consults the national competition authorities, and then the final decision is made by the full College of Commissioners. The parties to the case are informed directly of the decision, and at the same time the Commission issues a press release on key details of the decision, which includes the amount of the fine imposed on each infringing firm. If the cartel was reported by one of its members (leniency application), the fine can be reduced for this particular firm. Our study focuses on these two main announcements, and their effect on firms' share prices. This part of our analysis is similar to [Aguzzoni et al. \(2013\)](#), but has a newer and more extensive dataset. We then study the interaction between the public sanction (EU administrative fine) and private sanctions on the cumulative abnormal rate of returns of shares.

Cartels are related party offences as it is the customer who directly suffers the harm, and therefore, based on previous literature, we would expect private (reputational) sanctions to have a deterrent

effect. However, we have to make an important distinction between two types of cartels. Previous literature often distinguishes between business misconduct that affects atomistic and non-atomistic customers, which is also relevant for our study of cartels. By atomistic customers, we refer to cases where the number of customers is so high that no individual customer can significantly influence the overall deterrence level and the harm on each atomistic customer is so small that it is likely to remain unnoticed. These tend to be the cartels that directly affect the end-consumer (e.g. Bananas cartel). Under non-atomistic customers, we refer to cases where customers are large and few - this is typically true in upstream contractual relationships (e.g. Steel-abrasives cartel). Non-atomistic customers are often aware of the conviction of a cartel and can more credibly commit to a 'punishment' [Alexander \(1999\)](#). In our data, we group cases by end-consumer and intermediary cartels to refer to these two groups of cases respectively. In intermediary cartels, the parties that are in direct contractual relationship with the cartel are other businesses. Intuitively, these parties should become aware of the offence even at low levels of media exposure (because they are more likely to be informed of the offence as soon as public enforcement reveals it), which means that media exposure and our measure of reputational effect is less likely to play an important role. By contrast, in end-consumer cartels a low level of exposure may mean that the cartel goes under the radar from a consumers' perspective. In these cases, the level of media exposure can play a prominent role, as it can help improve awareness, which is necessary for the reputational effect to take place. Wide exposure of a cartel leads to more informed atomistic customers. Moreover, the sentiment of the exposure is also expected to contribute to the reputational effect.

When it comes to cartels, interestingly, the academic discussion on the optimum amount of fines typically circumvents the issue of private (reputational) sanctions. Most discussion is limited to the optimal magnitude of the administrative or criminal fine, or the possibility of custodial sentences. For monetary sanctions the argument is that, they should account for the total social cost of the cartel. [Karpoff and Lott Jr \(1993\)](#) argues that in the case of fraud this would lead to over-deterrence because it ignores the effect of private sanctions. For cartels, there seems to be an understanding that too high sanctions on cartel activity do not chill any legitimate, pro-competitive conduct that could be mistaken for cartel activity; therefore, over-deterrence is not an issue. Whilst we are not convinced that this is true for some vertical agreements, there is another problem with overly stringent fines - that they may cripple the business and force them to exit the market, thereby potentially making it even less competitive.

Moreover, we believe that neither public nor private sanctions should be studied individually on their own. Size and gravity of determinants of private sanctions are driven by the magnitude of public sanctions - in which case the public sanction acts as a signal to the gravity of the offence - i.e. without public sanctions, private sanctions would not be effective [Iacobucci \(2014\)](#). On the other hand, the effectiveness of public sanctions may depend on the presence of private sanctions and on the underlying environment. This would mean that for public sanctions to be effective they would have to be administered as part of a cocktail with private sanctions, and the relative dosage would depend on the context of the case.

One of the main findings of our research is that public sanctions work well for cartels higher up in the supply chain (intermediate cartels), but are not fully effective for end-consumers cartels. In end-consumer cartels for fines to be effective in deterring misconduct, it should be applied in combination with private sanctions. This is evidence that in cases with atomistic customers, private and public sanctions are complements for deterrence. The paper proceeds with a brief introduction of the institutional setting of European anti-cartel enforcement. We then look at the various types of data sources needed for the study, and in Section 4 we present the methodologies. Section 5 discusses the results and looks at whether public and private sanctions are substitutes or complements in deterring misconduct.

3. DATA

Our data is based on cartels that were prosecuted by the European Commission. The data is made of information on cartel characteristics and the list of companies that participated in the cartel activities. For the population of listed (public) cartel members we collated information on share price and market performance, along with their capitalisation, prior and post the Commission's detection and decision cartel dates. Finally, to gain insight on the possible reputational damage, we put together a dataset made of media articles (newspapers, magazines and news agencies); this to document reports on the cartel (and cartel members) misbehaviour. We describe each piece of data source separately and provide a cohesive discussion towards the end of the section.

3.1. Cartel data. We collected information on cartel characteristics and dates of detection and decision for 150 European private cartels convicted by the Commission during the period 1992-2015. The information is retrieved from public documents available on the Commission's website.⁵ The documentation includes cartels that operated in final or intermediary manufacturing and service

⁵See <http://ec.europa.eu/competition/elojade/isef/index.cfm> [webpage consulted May 2018].

industries. The sources that we have accessed are non-confidential versions of decisions adopted by the Commission, including: summary decisions published in the Official Journal of the European Union - EUR-Lex, reports from the Hearing Officer, opinions of the Advisory Committee, Commission’s press releases on adoptions of decisions and, where available, Commission memos on inspections, statements of objections or Court judgements.

A summary of cartel characteristics is offered in Table 1, which reveals some issues due to missing information. In particular, it was not possible to retrieve full information on cartel coverage of the market, on the end-consumer identifier,⁶ and on the existence of a ringleader for a number of cartels. For 29 cartels, we could not find any information on their characteristics. Nonetheless, for the cartels we have information on, we note that, on average, cartels lasted less than 8 years, were composed of about 7 firms, and covered 83% of the market. Over 80% of cartels involved price fixing, and two thirds of cartels had market share agreements.⁷

TABLE 1. Cartel summary statistics

Variables	N	mean	sd	min	max
<i>cartel characteristics:</i>					
convicted (year)	104	2006	5.71	1992	2015
coverage	68	0.83	0.19	0.11	1
detected (year)	121	2002	6.31	1983	2014
duration (years)	103	7.77	6.29	0	34.8
end-consumer	150	0.37	0.48	0	1
ring-leader	92	0.27	0.45	0	1
size	103	7.34	8.13	2	76
<i>cartel type (non-exclusive):</i>					
bid rigging	109	0.18	0.39	0	1
market share allotment	109	0.63	0.48	0	1
price fixing	109	0.84	0.36	0	1
quota allotment	109	0.34	0.46	0	1
<i>cartels</i>	150				

3.2. Cartel member (firm-level) data. Along with the cartel characteristics, we gathered details on the firms that participated in the cartel activity. The documentation provides information on

⁶For this particular variable we managed to fill out the missing information, as in many cases it was obvious when a cartel was end-consumer or not.

⁷For most of the analysed period, settlement was not an option. Therefore, our sample does not contain settlement cases.

the name of the firms that took part in the cartel, the fine they were charged before leniency was applied, the percentage of leniency reduction, and the new fine calculated after the leniency discount. An example of the information that is available is provided in Table 2 for the Air Cargo cartel, labelled in the Commission’s documents as “Airfreight” cartel. Fourteen firms belonged to that cartel, of which Lufthansa (and its subsidiary Swiss Airlines) received full immunity from fines, as it was the first to apply for leniency and help with the cartel investigation.

TABLE 2. Firm fines (in million Euros)

Cartel	Firm	Fine before	% of leniency reduction	Fine after
Airfreight	Air Canada	24.75	15	21.04
Airfreight	Air France	228.65	20	182.92
Airfreight	British Airways	115.60	10	104.04
Airfreight	Cargolux	94.00	15	79.90
Airfreight	Cathay	71.40	20	57.12
Airfreight	Japan Airlines	47.60	25	35.70
Airfreight	KLM	158.95	20	127.16
Airfreight	LAN Chile	10.28	20	8.22
Airfreight	Lufthansa	0	100	0
Airfreight	Martinair	59.00	50	29.50
Airfreight	Qantas	11.10	20	8.88
Airfreight	SAS	82.55	15	70.17
Airfreight	Singapore Airlines	74.80	0	74.80
Airfreight	Swiss International Airlines	0	100	0
Total		978.66		799.45

The full dataset of cartel member accounts for 767 firms –13% of those are recidivist. Some of these firms are publicly listed, and for these we collected information on their share prices around the detection and decision date, as discussed in the next section.

3.3. Stock market data. A third dataset includes cartel members’ share prices, their capitalisation and corresponding market value. We downloaded daily share prices (adjusted for dividends) for all listed firms in our sample from Datastream. We also downloaded daily prices for their respective home market index, as well as their market capitalization in their home market.⁸ Daily prices spanned from one year before the detection and decision dates, to one year after each of these dates. For a small number of companies we could not retrieve share prices prior to the detection

⁸We used a major, broad, capitalization-weighted index of the local (home) market of the firm (Campbell et al. (2010)). For example, for British firms we used FTSE 100, for US firms we used S&P 500, and so on. For developing countries with no data on such indices, we used the corresponding Datastream calculated index.

date (because they had not become public yet), and for an even smaller number we were unable to find data before the decision date (because the companies had been de-listed or bought out by that time). This selection mechanism produced a final sample of 339 publicly listed firms, which had share prices either around the raid or around the decision (or around both periods).

3.4. Media articles. The last fragment of data consists of news articles on the cartel and cartel member behaviour, downloaded from Nexis® service of the LexisNexis information solution. Nexis® aggregates information from a huge body of international news, business articles, business-relevant websites, blogs and forums. The Nexis search engine accepts individual words or strings, and then identifies and retrieves thousands of articles that contain the specified word(s).

For each cartel, we collated English written news that reported and described cartel behaviour during the time window: one day before and after the cartel decision.⁹ We searched according to the boolean rule: “name firm1” OR “name firm 2” OR ... “name firm N” AND “price fix” OR “cartel”. To be more inclusive, when appropriate, we employed both the original name of the company and its abbreviation with the use of the Boolean OR (e.g. “British Airways” OR “BA”). The period of the search was extended from the day before the official EU press release detailing the cartel conviction decision, to the day after. By including the day before the announcement we aimed at capturing media articles that discussed the imminent decision of EU on the day before (if there was any leakage of information). With the inclusion of the day after we aimed to capture print news sources that were late in reporting the European Competition Commission’s decision, either due to time zone differences or the fact that European newspapers are normally printed in the morning, hence may miss the EU decision on the day it takes place.

With our search rule, we have gathered 1,534 different news articles. Texts were not included when they were irrelevant or made up a very small part of a longer article. In cases where the cartel has been the primary focus of an article (no matter how short) the text was included. Five cartels have fallen off the articles watch list: 1) Cewal, Cowac and Ukwal, 2) Quantel International, 3) Reinforcing bars (Italy), 4) Sodium Gluconate, 5) Trans-Atlantic Conference Agreement. Texts

⁹We opted for publications in the English language only. This may result in a bias in favour of publications from English speaking countries and firms. However, our decision is based on two premises: Firstly, it would be impractical, if not impossible, to include in our search string the translated terms “cartel” and “price-fix” in all languages. Secondly, not specifying the terms “cartel” and “price-fix” to allow for all languages would generate much noise (i.e. company-related news irrelevant to the cartel conviction decision). Furthermore, these news pieces can be in languages that we do not command, and distinguishing between relevant and irrelevant news releases would be an impossible endeavour. Finally, all the cartels in our sample are of international nature and were likely to have been reported by English language news sources.

from the original article have been copied across exactly as they were (with typing/grammatical errors left in place). When the text was too long and irrelevant, only the relevant part was copied.

Articles typically differ in length, number of firms they list, and in the opinion, they deliver to the reader. Take the *Banana cartel (2009)* as an example of an end-consumer cartel in our taxonomy. 15 news articles covered that cartel (see Table 3), and there is variation in their length (and content), but also in the number of firms (companies) that are cited. Articles may refer to a single company, multiple companies or no companies at all, as it happens when articles do not mention any company name, and talk only about the cartel. For the *Banana cartel (2009)*, there is limited variation in the number of firms mentioned in texts, but this is not a common pattern.

TABLE 3. News articles about the “Banana” cartel

Cartel	Source	Words	Title	N firms
Banana	Daily Mail	134	Fyffes is cleared in price-fixing probe	3
Banana	Edmonton Journal	237	Two banana importers skinned by EU for \$82M	3
Banana	European Report	413	Cartels: 60.3 million euro in fines for banana cartel	3
Banana	Irish Independent	388	Fyffes escapes EU fine after major banana price-fixing	4
Banana	The Toronto Star	135	Dole, Del Monte fined for banana price fixing	4
Banana	Agence France-Presse (English)	143	EU squashes banana cartel	3
Banana	Associated Press Financial Wire	244	EU fines banana importers for cartel actions	3
Banana	Associated Press Financial Wire	235	EU fines banana importers for price fixing	3
Banana	Associated Press Financial Wire	95	EU fines banana importers for running cartel	3
Banana	Business World (Digest)	198	Fyffes escapes EU E60m banana fine	3
Banana	Just-food Global News	187	EU: Commission fines banana cartel	3
Banana	RTE News	380	Fyffes escapes EU banana fine	3
Banana	Associated Press International	106	EU fines banana importers for running cartel	3
Banana	Associated Press International	237	EU fines banana importers for cartel actions	3
Banana	Associated Press Online	237	EU fines banana importers for price fixing	3

To give flavour of the content of an article we quote underneath one of the text articles about Banana cartel. The article below mentions all three-cartel members and the amount of the fine for all firms.

Banana importer Fyffes has escaped a €60m fine levied by the EU on its rivals Dole and Weichert for price fixing. The European Commission found that the two had participated in a cartel between 2000 and 2002. Fyffes acquired its 80% interest in Dole and Weichert on January 1, 2003, but the court found that the price fixing did not continue after the buy-out. Another banana importer, Chiquita, was also found to be involved in the cartel, but was not fined as it provided information to the Commission, allowing officials to open their investigation. California-based Dole was fined €45.6m, with the German Weichert company and its U.S. partner Del Monte jointly accountable for a €14.7m fine. Fyffes has been under investigation since July last year, when the EU Commission charged it with operating a cartel. *Daily Mail*, *October 16, 2008*.

3.5. General overview of the data. Summing up, in this paper we assemble four different datasets. One difficulty we had to face in combining the datasets is that there was no uniform convention on naming the firms. While it was not much of a problem merging the Commission and share price datasets, it was challenging to cope with the news article data, as there, the same firm was named differently in alternative news articles. This complicated the identification of unique firms within the same cartel and the merging of news articles with the other databases. For example “British Airways”, appears shortened as “BA”, or with a dash “British-Airways” or in modified versions, such as “British Airway” or “BritishAirway”. Additional complexity was to deal with non-English firm names, such as “Société des Industries Chimique du Fluor” or “Novácke Chemick Zvody and 1.garantovaná”. We addressed this challenge by constructing a dictionary of synonyms for combinations of firm names. By fixing the firm’s name synonyms, we managed to retrieve 728 observations of firms (a small proportion of which are recidivist firms) out of the original Commission’s database of 767 firms. Of those firms, 339 are publicly listed and have data around either or both raid and decision periods.

4. METHODOLOGIES

In this section, we give an overview of the two main methodologies used in our analysis: event study, and opinion mining (sentiment analysis). Though the efficient market hypothesis literature introduced by [Fama \(1965\)](#) and then extended by [Malkiel and Fama \(1970\)](#) has been criticized by behavioural finance ([Kahneman and Tversky \(1974\)](#) and [Shiller \(1981\)](#)), its core – that information integrates into share prices immediately – still remains a principle widely accepted in the business, economics and finance literature. Recent development of text analysis contributes to this literature with sophisticated tools able to produce richer secondary data to study the relationship between share markets and opinion ([Van de Kauter et al. \(2015\)](#)).

4.1. Event study. We calculate the firm and market index return by taking a first difference of the corresponding log share prices. We use the market model (see [Brown and Warner \(1980\)](#) and [Brown and Warner \(1985\)](#)) to obtain a counterfactual return, and then employ a standard event study methodology ([MacKinlay \(1997\)](#)) to compute the daily abnormal returns (AR) for individual firms, and their cumulative version (CAR) over a number of different event windows. Given that part of our data overlaps with that in [Aguzzoni et al. \(2013\)](#), we benchmark our results to theirs

(see Table 9 in the Appendix for a throughout comparison).¹⁰ The window for CAR spans from 20 days before the detection or decision dates, to 10 days after (31 days in total). The null hypothesis that the cumulative average abnormal return (CAAR) is zero is tested against the alternative that is greater than zero, this is tested based on the adjusted BMP test (see [Kolari and Pynnönen \(2010\)](#)). This test has the advantage of accounting for cross-sectional correlation, while being robust to serial correlation.

4.2. Sentiment analysis. Text mining is the process of extracting useful information from unstructured data, such as text documents, e-mails and HTML files. Various non-exclusive techniques have been developed in the literature to study unstructured texts (see for example, [Hotho et al. \(2005\)](#), [Gupta and Lehal \(2009\)](#), [Gonçalves et al. \(2010\)](#), and [Vijayarani et al. \(2015\)](#)). Text can be analysed via tokenisation (text split into a set of terms), filtering (discharge of words that provide little or no information), lemmatization (mapping of verb tenses into their base tense and plural nouns into their singular form), and stemming (mapping different forms of words into a common root/stem). We use sentiments analysis (opinion mining) to understand the sentiments (or opinions) being presented in the media reports. Sentiment analysis is the computational analysis of the opinion, sentiment, and subjectivity in a text. This is done by speech tagging: breaking down the semantic structure of sentences and determining which emotional words apply to the keyword. For the purpose of this article, we employ SentiWordNet; a lexical resource freely accessible for opinion mining, as described in [Esuli and Sebastiani \(2006\)](#) and [Baccianella et al. \(2010\)](#). This lexical package has already been employed widely in the academic literature (see <http://sentiwordnet.isti.cnr.it/>).¹¹ The main feature of SentiWordNet is that it associates each word with three numerical weights. A first weight is the likelihood that the meaning of the word is positive, the second one that it is neutral, and the third weight is the probability that the word has negative connotation. The sum of the three weights is one. The three numerical weights determine the positivity, negativity and objectivity of the “synset” (word). In addition to these numerical values, each term is presented with its part of speech tag (synsets, such as: adjective, noun, etc.), as each speech tag can have different polarity. Each synset in the lexicon can have multiple senses (meanings) which are integer numbers and are represented in the lexicon as “synset#sense”, and a list of synonyms. For example, the word fine as adjective is represented as “fine#1”, “fine#2”,

¹⁰There is some misalignment in the results, because [Aguzzoni et al. \(2013\)](#) took the index of the market where the firm had the highest market capitalization, whereas we have chosen the local market.

¹¹Accessed on 15 May 2018.

etc. Sense one (synset#1) refers to the most frequent use of a term and various term senses may have different polarities.

Our sentiment analysis is conducted on 1,534 articles, each documenting the behaviour of one of the cartels prosecuted by the European Commission. From the population of articles we retrieve 10,056 words. We organize articles in rows and words in columns, and produce a frequency matrix for each word in the article. Next, we expand the original lexicon of 117,659 words by adding synonym synsets in independent columns, so to have a final lexicon of 206,941 words. After the expansion each word has its own sense, identifier, gloss, and triplet score (negativity, positivity, and objectivity, respectively). This expansion process was necessary because there are words in the cartel domain that have different sentiments than recorded in SentiWordNet lexicon. For example, the synset *cartel* has been stored with five synonymous labels, *sanction* with three, and so on. After the expansion process was completed, we selected a list of words that in the cartel literature have a special meaning, which would not be captured by the lexicon. The list of manual coding of single words and bigrams that we have imputed is given in Table 4.

Two main approaches are in use in the literature to deal with multi-meaning terms. [Hamouda and Rohaim \(2011\)](#) suggest retaining the most popular term of each polarity and parts of the speech. The second approach, put forward by [Amiri and Chua \(2012\)](#), recommends ignoring the word sense disambiguation by taking an average score within each polarity and part of speech of the same word. Each of the two procedures produce the same reduction of lexicon terms, from 206,941 to 155,387. We experiment with both methods. The matching between the 10,056 words obtained from all cartel articles and the 155,387 lexicon terms gives 6,635 pairs.¹² Then, rather than associating a categorical outcome to each word (positive, neutral or negative), we calculate numerical scores in the domain $[-1, 1]$.

We begin the analysis of article scoring by relying on the most common sense of words. As expected the great majority of the articles produce a negative score (1,470 out of 1,534); 55 generate a positive score and 3 are categorized as neutral. However, for the type of analysis that we wish to undertake, neutral terms are not so informative, so we remove the neutral terms and concentrate on positive and negative terms. The density of the sentiment is represented in Figure 1.

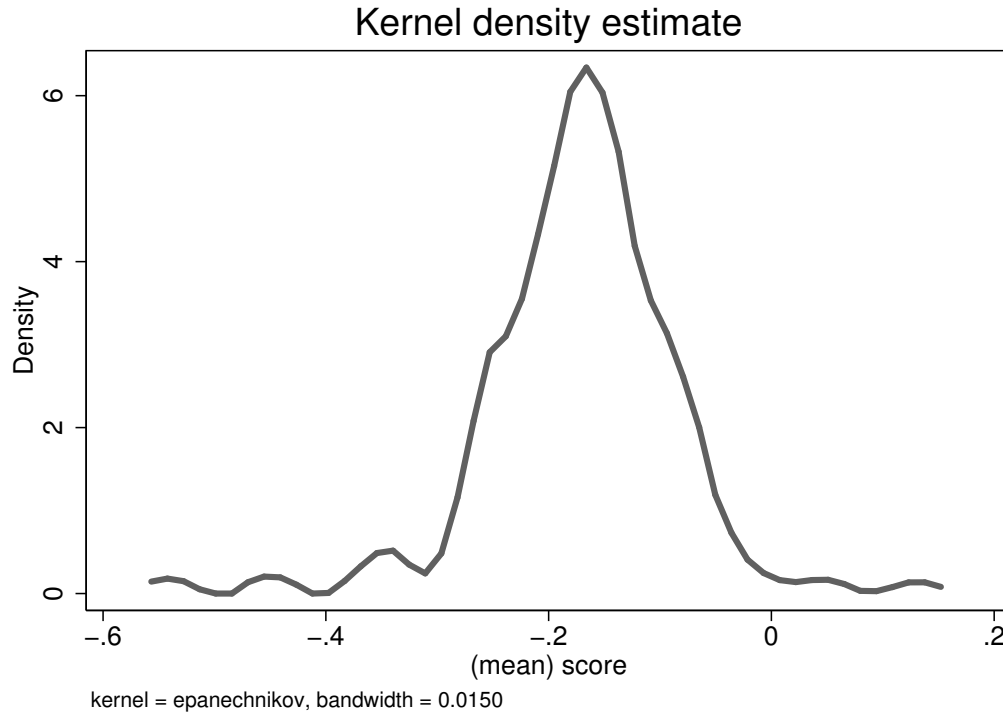
¹²The words that did not match are mainly words for currency (e.g. *eu85_n*, *eur104m_n*, ...), names (e.g. *william_n*, *denis_n*, ...), or words with no English meaning (e.g. *raza_n*, *roca_n*). Other difficulties that we came across were words that did not appear in lexicon, such as: *laundry_n*, *largest_a* or *logistic_n*. There are also cases of mistagged words, for example *live_v*, rather than *live_n*, or *lead_a* as adjective rather than as verb or noun.

TABLE 4. Manually weighted words for cartel offences

POS	PosScore	NegScore	SynsetTerms
Single words			
n	0.25	0	amnesty
v	0.25	0	amnesty
a	0	1	criminal
n	0	1	criminal
n	0	0.5	damage
v	0	0.5	damage
a	0.5	0	exempt
n	0.5	0	exempt
v	0.5	0	exempt
n	0	0.05	fine
v	0	0.05	fine
n	0	1	jail
v	0	1	jail
n	0.25	0	leniency
n	0	1	prison
v	0	1	prison
n	0	0.05	sanction
v	0.5	0	settle
n	0.5	0	settlement
Bi-gram words			
c	0	0.25	fix-prices
c	0.5	0	full-leniency
c	0	0.75	high-penalty
c	0	1	highest-penalty
c	0	0.25	inflated-price
c	0	0.75	large-fine
c	0	0.25	price-fixing
c	0	0.25	price-increase
c	0	1	repeat-offender
c	0	0.25	small-fine
c	0	0.25	small-penalty

We have also experimented with the stemming technique. We exert the stemming procedure to both the lexicon and the words from our articles, and as a result, the two datasets drop to 9,874 and 149,904 words, respectively. The stemming methodology brought in new challenges as we had

FIGURE 1. Kernel density sentiment by firm



words with the same linguistic root and parts of the speech, but completely different sentiment in the lexicon. For this reason, we found this methodology unsuitable for the purpose of our analysis. Examples of the difficulties are presented in Table 5.

4.3. Econometric model. In much the same way to [Jarrell and Peltzman \(1985\)](#) and [Karpoff et al. \(2008\)](#) we regress the cumulative abnormal rate of return (shortened with C in the notation below) at decision, against public and sources of private sanctions, among other controls but we do that in a semiparametric way. The fine, net of the leniency reduction, inflicted by the Commission and normalized by market capitalisation seizes public sanctions (F).¹³ Private sanctions are proxied by two measures. The first one is media intensity (exposure, E), which is given by the number of articles documenting a cartel member misconduct. The second one is the average (by firm) sentiment of these articles (S). The last main variable of interest is a dummy set to one when the company was part of an end-consumer cartel ($D = 1$) or not. We regress CAAR (C) against a set of control variables (mainly cartel-level variables), and a function of the four key variables. The

¹³This normalisation follows [Aguzzoni et al. \(2013\)](#) and is aimed at indirectly controlling for firm size.

TABLE 5. Stemming procedure

Original word	POS (part of speech tag)	Sentiment	Stemmed word
abb	n (noun)	0	abb
abbe	n (noun)	0.125	abb
abuse	n (noun)	-0.75	abus
abuser	n (noun)	-0.25	abus
acceptability	n (noun)	0.5	accept
acceptance	n (noun)	0.375	accept
acception	n (noun)	0.5	accept
accord	n (noun)	0.125	accord
accordance	n (noun)	-0.375	accord
achievement	n (noun)	0	achiev
achiever	n (noun)	0.25	achiev
acid	n (noun)	-0.25	acid
acidity	n (noun)	0.125	acid
adamance	n (noun)	-0.375	adam
adamant	n (noun)	0	adam

econometric equation for the firm j is:

$$C_j = g(D_j, E_j, F_j, S_j; \phi) + x_j\beta + \varepsilon_j, \quad j = \{1, 2, \dots, J\}. \quad (1)$$

Given the interest in the end-consumer cartel coefficient, we do not add cartel dummies, but control for cartel characteristics. The row vector x includes the control variables: cartel size, cartel members, cumulative abnormal rate of return at detection (to test for anticipated effects on abnormal returns around the decision date), and a dummy variable for recidivist firms. The notation employed in Equation 1 suggests that the dataset is cross-section, but the presence of recidivist firms would have made a panel notation more appropriate.¹⁴ However, as only 13% of the firms are recidivist, we maintain the light touch cross-sectional notation.

5. RESULTS

In this section, we first discuss the predicted abnormal rate of returns and then address the effect of private and public sanctions on the (cumulative) abnormal rate of returns. Table 6 displays the average abnormal rate of return from 20 days prior to the event, to 10 days after the event, where

¹⁴For example, Atochem and Akzo appear in the original dataset 9 and 7 times, respectively.

the event represents either the raid or the decision about the cartel conviction. The table also reports the p-value of one-tailed test J -statistic.¹⁵

TABLE 6. Predicted abnormal rate of returns at the raid and at decision (%)

	Raid		Decision	
	Mean	J p-val	Mean	J p-val
	(1)	(2)	(3)	(4)
Days to event	AAR			
-20	0.080	0.169	0.005	0.321
-19	-0.160*	0.078	0.071	0.421
-18	0.015	0.212	0.198	0.198
-17	-0.075	0.246	-0.349	0.066
-16	0.080	0.442	0.143	0.317
-15	0.093	0.297	0.121	0.268
-14	-0.098	0.404	0.138	0.215
-13	0.238	0.448	-0.010	0.415
-12	-0.125	0.348	0.056	0.347
-11	-0.264	0.240	-0.283*	0.076
-10	0.042	0.349	-0.093	0.500
-9	-0.629***	0.002	-0.189	0.184
-8	0.223	0.108	0.045	0.497
-7	0.281	0.171	-0.101	0.184
-6	-0.438**	0.032	-0.197	0.135
-5	0.104	0.281	0.033	0.404
-4	-0.051	0.351	0.046	0.298
-3	-0.188	0.484	-0.101	0.146
-2	0.295	0.133	-0.163	0.118
-1	0.187	0.219	-0.164	0.195
0	-0.728*	0.064	-0.330*	0.095
1	-0.481**	0.011	-0.187	0.343
2	-0.284*	0.075	0.059	0.162
3	-0.065	0.468	0.075	0.420
4	0.599*	0.066	-0.216	0.200
5	-0.153	0.491	-0.025	0.456
6	0.224	0.243	0.018	0.302
7	-0.201	0.356	-0.024	0.420
8	-0.108	0.292	-0.013	0.376
9	-0.149	0.290	-0.179	0.172
10	0.097	0.268	-0.333*	0.082
Event window	CAAR			
$[-1, 1]$	-1.022*	0.054	-0.681*	0.061
$[-5, 5]$	-0.765	0.265	-0.972	0.190
$[-10, 10]$	-1.424*	0.065	-2.036**	0.034
Obs.	194		315	
One-sided test, significance levels: ***1%, **5%, and *10%.				

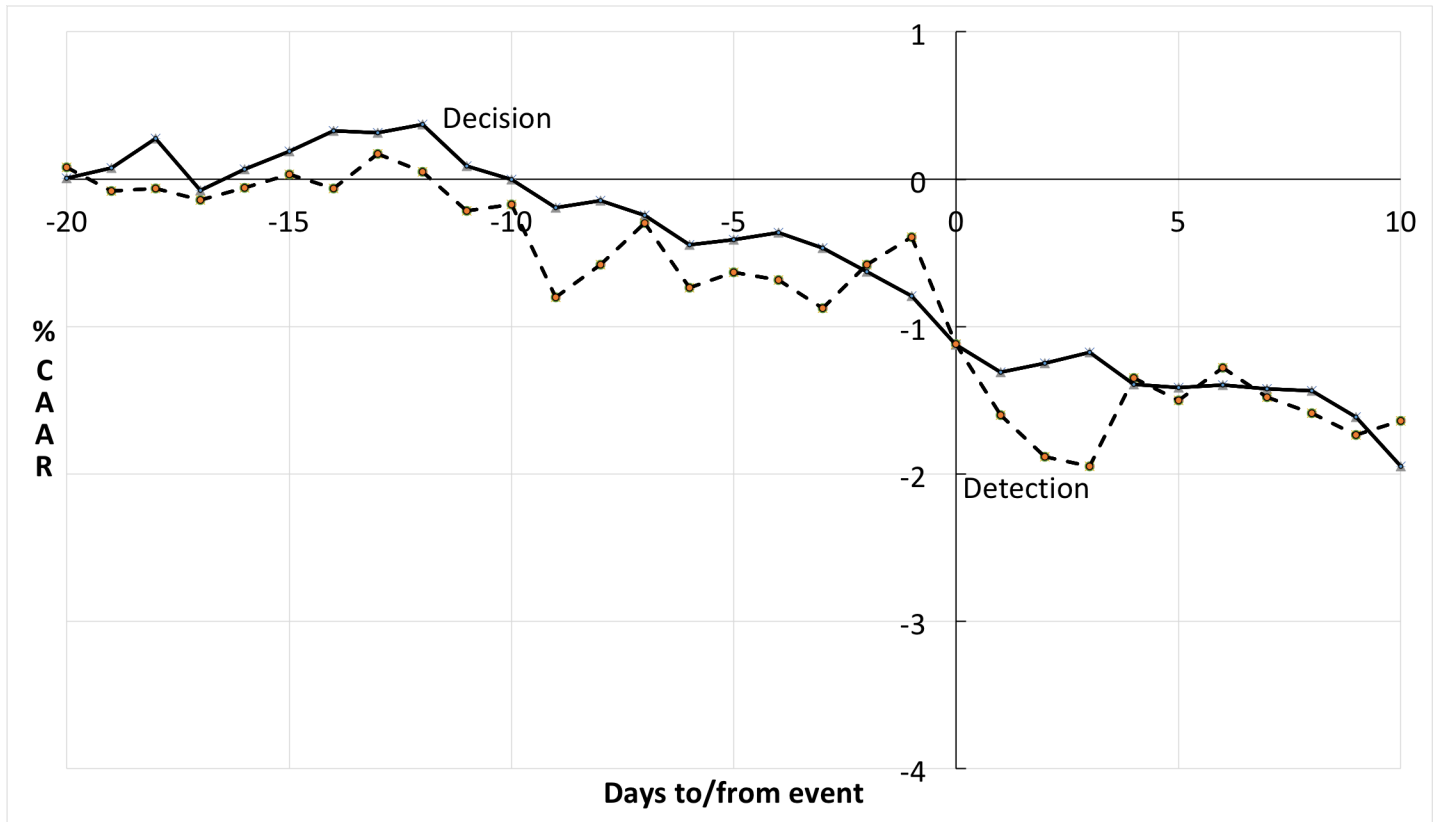
The average abnormal rate of return is negative and mildly significant both at the day of the raid, and at the day of the decision. The drop in share prices is more accentuated at the raid, 0.73%, than at decision, 0.33%. There are a couple of mildly significant drops in returns 6 and 9 days prior to the raid. The largest reduction occurs 9 days before the raid. This is not what one would expect as raids are supposed to be secret and therefore unanticipated. [Aguzzoni et al. \(2013\)](#) have investigated this anomaly.¹⁶ A sharp drop in price is not present around the decision date, as highlighted in the third column of Table 6.

¹⁵The abnormal rate of return estimation is conducted using the Stata package `eventstudy2`, written by [Kaspereit \(2016\)](#).

¹⁶They dropped cases that had previously been investigated in the US or where leniency had been applied to the cartel, but found that results were even worse (i.e. more accentuated drop in prices prior to the raid) when these problematic observations were removed.

Anticipation of the investigation of cartel is confirmed by a graphical inspection of the trend of the cumulative average abnormal rate of return captured by the dotted line in Figure 2, which shows a drop in the CAAR around the raid. Interestingly CAAR for the decision dates has a similar trend, but is smoother than CAAR for detection - with a less pronounced decline around the decision date (i.e. with larger anticipation effect).

FIGURE 2. % CAAR around the EU decision date [-1,1]



The analysis of the cumulative average abnormal returns displayed on the bottom panel of Table 6 shows that share prices significantly (or mildly significantly) drop around the raid. By looking at the [-10,10] window, the model predicts that the cartel decision deflates prices by 2.04%, of which negative 0.68% is cumulated in the immediacy of the decision (± 1 day). The CAAR suggests that there is a mild effect on share prices in the immediacy of the decision, but this is an average effect. There are firms whose cumulative share prices ± 1 day of the decision is largely positive (top 1% cumulative abnormal price is +9.62%), and firms where the effect on share prices is substantially negative (bottom 1% cumulative abnormal price is -17.18%). The standard deviation is 4.27%. This heterogeneity is exploited in the final stage of the empirical analysis, which is discussed in the next section.

5.1. The impact of private and public sanctions. We regress the cumulative average abnormal rate of return for each of the three time intervals displayed in the bottom panel of Table 6 against a set of control variables and the four key variables included in the g function in Equation 1. We conduct the analysis only at the decision date because very few (in most cases zero) media articles were published around the raid.

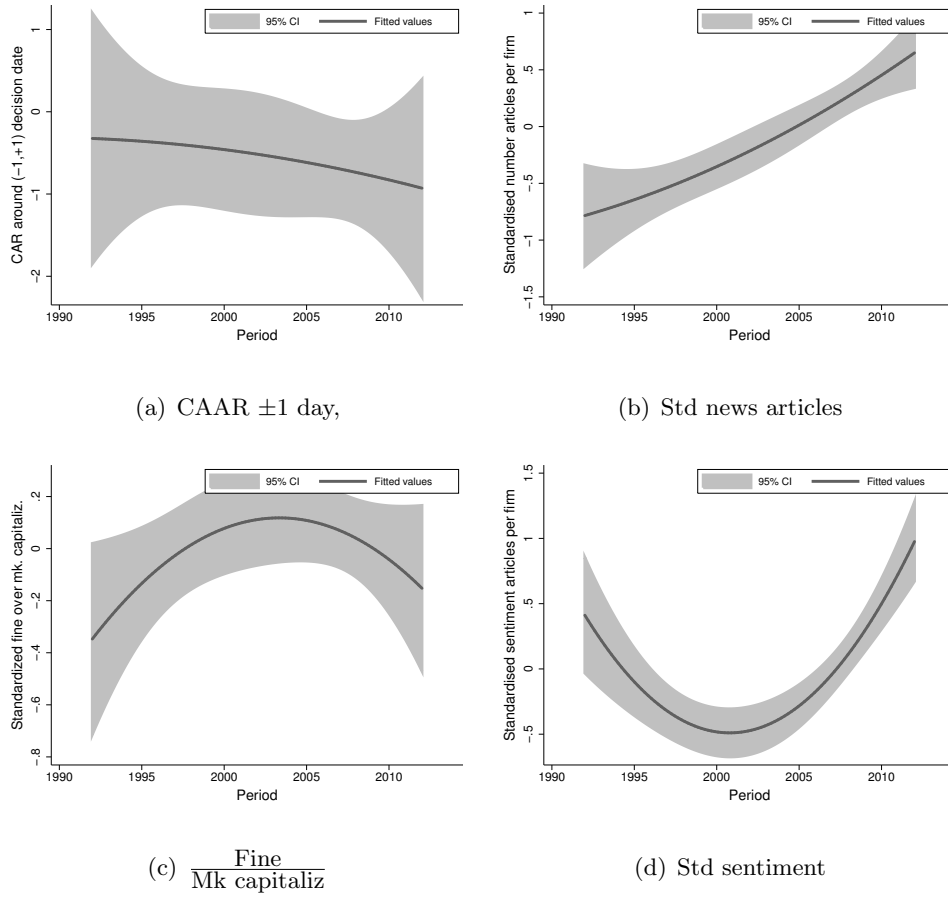
The time trend of the four key variables is plotted in Figure 3. It can be seen that CAAR $[-1,1]$, and the number of news articles are characterised by a steady trend, downward the former, and upward the latter. By contrast, standardised fine over market capitalisation and standardised sentiment display an inverse U-shape and U-shape relationships, respectively. There seems to be an inverse relationship between normalised fines and standardised sentiment, but not clear pattern between number of news articles and fine emerges. In the sentiment analysis we did not include the fine in the analysed texts (the amount was excluded from the text), however even with this exclusion, it is normal to expect negative correlation between the fine and the sentiment. It would look odd to see that most of the positive deviations of fines (large fines) are matched with positive deviations of the sentiment (positive or not so negative news about the misconduct).

The regression results are reported in Table 7. We have information on the CAAR for 300 publicly listed firms, but 14 observations were not suitable to be included in the analysis as they presented a value of fine over market capitalisation (in excess of 30%), which is the limit set by the Competition Commission. We thus dropped those observations and are left with 286 observations. This sample size appears in the first three columns of Table 7. Columns 4-9 register an additional drop in the number of observations, caused by unavailability of data on exposure and sentiment (57 firms).

The baseline regressions (columns (1-3)) for each of the CAAR windows do not include the two sources of private sanctions. Columns (4-6) account for the two determinants of private sanctions, and columns (7-9) account for the interaction terms of the three key variables and end-consumer cartel dummy. The variables used as controls are cartel size, number of cartel members, a dummy for recidivist firms, a dummy indicating whether leniency was applied to that cartel, and a dummy for observations that had no data on cartels (73 out of the 286 observations employed in columns (1-3), and 16 out of 229 observations used in columns (4-9)). This latter dummy allows us to retain useful information available about other variables.

Fine over market capitalisation appears to affect share prices in the shorter event windows, and exposure or sentiment have a significant effect when the time window widens. This is what we

FIGURE 3. Key variable trend



had intuitively expected, as media coverage appears with a short delay. Only in column (1), of the first six columns of results, the variables are (mildly) jointly significant. However, what matters for the rest of the analysis is that the regressions in columns (7-9) are jointly significant, as we will calculate marginal effects from those results.

Because of the large number of interaction terms in columns (7-9), the coefficients of our measures of public and private sanctions in Table 7 are not simple to interpret, which is why in Table 8 we report the marginal effect of the public sanction given various levels of private sanctions. We break down the cases into intermediary and end-consumer cartels.

We identify low, middle, and high fines, sentiment, and exposure. A low value is calculated as one standard deviation (SD) below the mean, a middle value is the mean value of the standardised variable, and a high value is one SD above the mean. As fines, sentiment and exposure are standardised, one SD is a unit value. The marginal effects on CAAR of one unit (one SD) increase in fine are shown for each of the four time windows and levels of exposure and sentiment in Table 8. For

TABLE 7. Linear regression analysis using windows of percentage CAR as dependent variable

Time window	(1) [-1,1]	(2) [-5,5]	(3) [-10,10]	(4) [-1,1]	(5) [-5,5]	(6) [-10,10]	(7) [-1,1]	(8) [-5,5]	(9) [-10,10]
constant	-0.451 (0.868)	0.873 (1.706)	-1.693 (2.252)	-0.693 (1.057)	3.148 (2.134)	2.948 (2.878)	-1.560 (1.150)	2.268 (2.285)	3.887 (3.260)
D	-0.824 (0.575)	0.343 (0.996)	1.965 (1.315)	-0.653 (0.719)	-0.054 (1.277)	1.833 (1.590)	-1.060 ^c (0.640)	-0.206 (1.083)	1.555 (1.631)
F	-1.006 ^a (0.338)	-0.389 (0.597)	-0.728 (0.916)	-1.152 ^a (0.359)	-0.615 (0.534)	-0.989 (0.897)	-1.209 ^a (0.397)	-0.973 ^b (0.476)	-1.110 (1.122)
E				-0.106 (0.244)	0.315 (0.415)	1.119 ^c (0.596)	-0.188 (0.486)	0.448 (0.868)	1.846 (1.197)
S				-0.048 (0.396)	1.155 ^c (0.613)	1.189 ^c (0.679)	0.649 (0.616)	1.784 (1.401)	0.616 (2.000)
DE							0.195 (0.581)	-0.011 (1.005)	-0.780 (1.292)
DF							1.653 ^a (0.591)	2.317 ^b (1.002)	0.880 (1.497)
DS							-0.713 (0.821)	-0.176 (1.652)	1.857 (2.361)
EF							0.292 (0.982)	-0.573 (1.413)	-0.553 (2.402)
ES							1.312 (0.882)	0.969 (1.819)	-0.601 (2.458)
FS							0.783 (1.396)	0.405 (2.452)	-1.076 (4.309)
DEF							0.053 (1.072)	1.212 (1.596)	0.904 (2.563)
DES							-0.099 (0.947)	0.526 (1.951)	-0.038 (2.670)
DFS							-2.391 (1.557)	1.051 (2.772)	1.509 (4.620)
EFS							0.765 (1.998)	0.785 (3.316)	-1.613 (5.629)
DEFS							2.327 (2.189)	2.743 (3.604)	2.358 (6.008)
F-statistic	1.777 ^c	1.629	1.696	1.510	1.470	1.392	2.121 ^a	5.819 ^a	2.122 ^a
R-sq	0.074	0.052	0.047	0.100	0.080	0.058	0.134	0.100	0.067
Obs	286	286	286	229	229	229	229	229	229

Significance level: ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.10$. Clustered (by firm) standard error in parenthesis. Control variables: cartel members, cartel duration dummy for 75 out of 286 observations with missing values, dummy for leniency application, dummy for recidivist firm, time trend.

example, one unit increase in standardised fine leads to a 1.52% drop in CAAR in the proximity of the decision if the cartel is an intermediary cartel and both exposure and sentiment were low. Conversely, one unit increase in standardised fine leads to an increase in the share price return by 4.54% if the cartel is end-consumer cartel with low exposure and sentiment. This result was expected, as large customers of the cartel are well aware of the misconduct and thus fines are effective even when there is minimal public noise about the cartel behaviour. By contrast, an increase in fines is not so worrying for an end-consumer cartel if it goes under the radar. This is because the realisation of no noise against the cartel misconduct might be seen ex post as good news by investors. On the

other end of the spectrum, high exposure damages the end-consumer cartel members only when the sentiment is negative; if ex-post the sentiment is positive (or not so negative), the effect on share prices can be positive. One unit increase in standardised fine over market capitalisation produces a 2.11% rise in cumulative share prices in the proximity of the decision. For intermediary cartels the effect of fines tends to be negative for different levels of exposure and sentiment.

TABLE 8. Marginal effect of fines at given values of exposure and sentiment

Expos / Sentim	Low	Middle	High	Low	Middle	High
regression CAR [-1,1]						
intermediary cartels			end-consumer cartels			
Low	-1.52 ^b (0.77)	-2.01 (1.48)	-2.50 (2.96)	4.54 ^a (1.58)	1.94 ^c (1.07)	-0.67 (1.23)
Middle	-1.51 (0.94)	-1.22 ^a (0.40)	-0.92 (1.15)	0.18 (0.47)	0.45 (0.47)	0.72 (0.75)
High	-1.50 (1.61)	-0.42 (1.42)	0.66 (3.99)	-4.18 ^a (1.21)	-1.03 ^b (0.50)	2.11 ^b (0.95)
regression CAR [-5,5]						
intermediary cartels			end-consumer cartels			
Low	-0.03 (1.32)	-1.40 (2.70)	-2.78 (5.69)	2.89 (2.71)	-0.13 (1.97)	-3.15 (2.08)
Middle	-0.42 (1.50)	-0.98 ^b (0.49)	-1.55 (1.46)	0.66 (0.92)	1.31 (0.89)	1.96 (1.31)
High	-0.81 (2.31)	-0.56 (2.29)	-0.32 (6.06)	-1.57 (2.28)	2.75 ^a (1.02)	7.06 ^a (1.73)
regression CAR [-10,10]						
intermediary cartels			end-consumer cartels			
Low	-1.09 (1.91)	-0.00 (4.72)	1.09 (10.40)	-0.22 (3.68)	-0.75 (2.09)	-1.29 (2.16)
Middle	-0.54 (2.10)	-1.10 (1.42)	-1.66 (3.12)	-0.70 (1.22)	-0.30 (0.98)	0.10 (1.40)
High	0.01 (3.03)	-2.20 (4.19)	-4.41 (10.33)	-1.18 (3.75)	0.15 (1.82)	1.48 (2.06)

Low=-1SD, Middle=mean, High=+1SD. Significance level: ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.10$. Standard error in parenthesis.

5.2. Public and private sanctions: substitutes or complements? Karpoff et al (1993) argue that public and private sanctions are non-perfect substitutes in terms of their deterrent effect. We provide evidence that in the case of cartels, the relationship depends on whether the cartel is end-consumer, or intermediary. In end-consumer cartels, the administrative penalty seems more likely to have a negative effect on the market valuation of the cartel if there is also reputational damage. This would imply that the two are complements. This seems intuitive if fines are directly proportional to cartel profit. If there is no reputational damage, (i.e. consumers are unaware of the cartel) businesses are less put off by the fine. This could be because they recover the public fine through higher future prices from customers. This would imply that for fines to have a deterrent effect, they would have to be accompanied by a reputational effect. In intermediary cartels, fines always have a negative effect, irrespective of how high the reputational effect is. What happens in this case is simply that our measure of reputational effect is not a good one, as customers of the cartel are more likely to be aware of the misconduct, irrespective of its public coverage; i.e. there is a potential reputational effect even where media coverage is little. The finding that administrative fines further reduce the valuation of firms would imply that the reputational sanction did not fully internalise all damages imposed, and adding a public sanction help do this. These findings are in line with Iacobucci (2014), who argued, “The reputational sanction that the wrongdoer bears from certain conduct will generally depend on the size of the legal penalty associated with that conduct.”

6. CONCLUSION AND DISCUSSION

We found that public sanctions are effective for intermediate cartels, as large business customers are typically informed of the misconduct. In fact, often a letter from these customers initiates the cartel detection procedure. By contrast, when cartels damage atomistic end-consumers, public fines are only effective if administered in combination with broad media exposure and use of language that lays bare the gravity of the conduct. This disseminated information can be seen as an endogenous factor, which can be influenced (controlled) by the regulator - for example if it wants to intensify the effect of private sanctions (naming and shaming). By ensuring that the public receives wider and more negative information on the discovered cartel, they can increase the reputational penalty.

17

¹⁷Of course, if the regulator were to use the cocktail of private and public sanctions on a more regular basis, then share prices might anticipate that. This would change the results presented in this work, possibly leading to no effect on high exposure for end-consumer cartels - as that would be anticipated - and larger positive effect for limited exposure - as this will be expected to be more of a rare event.

Although this paper is an application to cartel conduct, the evidence provided here has strong general policy implications. Most importantly, if private and public sanctions are indeed complements in cases with atomistic customers, then the fining bodies have to do a lot more to publicise the misconduct, and to alert the public of the damage caused by such conduct. In the specific case of cartels, there is a lot of scope for improvement, where many press releases use language that are less accessible for the general public.

This paper should be seen as a new framework to empirically evaluate the effectiveness of the combination of private and public sanctions using sentiment analysis to retrieve information on how costumers and consumers are informed about the misconduct. However, there are important aspects that this work was not able to cover, but are worth studying in the future. There is much to learn on richer information on the exposure to the news. We have used a straightforward count of news as metric of exposure, simply because we did not manage to capture the readership of the various sources. We did try to gather this information, but variation of readership over time and lack of information on readership for online and offline sources became too much of a challenge to have consistently reliable figures. Another aspect worth researching is the different use of language for domestic companies and international companies. One could study the presence of a bias for domestic companies. A similar distinction can be drawn between industry specialised news, news agencies, and consumer news, as they may use different languages and trigger different sentiments. These are ideas for future research on an area that there is still much to learn. Machine learning and artificial intelligence are fast evolving and their development helps making more of a routine the sentiment analysis conducted in this work.

APPENDIX A. TABLES

Table 9: Cartel characteristics

Cartel	size	year bust	year de- tec- tion	year con- vic- tion	dura- tion (in years)	ring leader	mar- ket cover- age	quota	mar- ket share allo- ca- tion	price fix- ing	bid rig- ging	NACE 2	end- consumer
UK Agric tractors													
Shipowners													
Quantel Internat													
Chemin de fer												H49	1
Cewal, Cowac and Ukwal	3	2003	1991	1992	2		0.81	1	1	0	0		0
Steel Beams	18	1991	1991	1994	3	0		1	1	1	0	C25	0
Cartonboard	19	1991	1991	1994	3	0		1	1	1	0	C17	0
PVC	12	1984	1983	1994	3	0		1	1	1	0	C22	0
Cement	76	1992	1990	1994	9	1		0	1	1	0	C23	0
Freight confer													1
Fenex	4	1991	1991	1996	4	1	0.11	0	0	1	0	H52	0
Ferry operators													1
Extra d'alliage	6	1995	1995	1998	4	0	0.92	0	0	1	0	C24	0
TACA													
British sugar	4	1990	1990	1998	4	1	0.92	0	0	1	0	C10	1
Gas switchgear	11	2004	2004	2007	16	1	1.00	1	1	1	1	C27	0
Greek ferries	7	1992	1992	1998	7	1	1.00	0	0	1	0	H50	1
FEG & TU													0
Steel tubes	8	1994	1994	1999	5	0	1.00	0	1	0	1	C24	0
FETTSCA	15	1992	1992	2000	23	0	0.73	1	1	1	0	H50	0
Amino acids	5	1995	1995	2000	5	1	1.00	1	1	1	0	C10	0
Carb de soude Solvay-CFK													1
SAS + Maersk Air	2	1998	1994	2001	2	1	1.00	0	1	0	0	H51	1
Graphite electrodes	8	1997	1997	2001	6	1	0.85	1	1	1	0	C28	0
Commissions bancaires													1
Vitamins	13	1994	1998	2001	9	1	0.91	1	1	1	0	C21	1
Interbrew + Alken Maes												C.11	1
Luxembourg brewing	4	2000	2000	2001	15	0	0.85	0	1	0	0	C11	1
Citric acid	5	1998	1995	2001	4	1	0.60	1	1	1	1	C20	0
Zinc phosphate	6	1998	1998	2001	4	0	0.98	1	1	1	0	C20	0
Commissions bancaires D	5	1999	1999	2001	4	0	0.39	0	0	1	0	K64	1
Carbonless paper	11	1995	1996	2001	4	1	0.90	1	1	1	0	C17	0
AU Banken	8	1998	1998	2002	4	0	1.00	0	0	1	0	K64	1
Methionine	3	1999	1999	2002	13	0	0.60	1	1	1	0	C20	0
Medical gases	7	1997	1997	2002	4	0	0.87	0	0	1	0	C20	0
Fine art auctions	2	2000	1997	2002	7	0	0.90	0	0	1	0	R91	1
Methylglucamine	2	1999	1998	2002	9	0	1.00	0	1	1	0	C20	0
Plasterboard	4	1998	1998	2002	7	0	0.99	1	1	1	0	C23	1
Graphite	8	1996	1999	2002	5	1	0.80	0	1	1	0	C20	0
Food flavour	4	1998	1995	2002	10	0	0.90	0	1	1	0	C20	0
Ronds bton													0
Sodium gluconate	5	1995	1997	2002	8	1	1.00	1	1	1	0	C20	0
Viandes Bovines													1
Sorbates	5	1996	1998	2003	18	1	1.00	1	1	1	0	C20	0
Carbon and graphite	6	1999	2001	2003	11	0	0.93	0	1	1	1	C28	1
Organic peroxyde	5	1999	2000	2003	29	0	0.93	1	1	1	0	C20	0
Tubes industriels	6	2001	2001	2003	13	0		0	1	1	0	C.33	0
CEWAL, MEWAC ...		1989	1989	2004	2		0.90	0	1	0	0	H50	1
Copper tubes	8	2001	2001	2004	13	0	0.79	0	1	1	0	C33	1
FR beer	2	1996	1999	2004	0	0	0.75	1	1	0	0	C11	1
Raw Tobacco (ES)	4	2001	2001	2004	5	1	0.98	0	0	1	0	C12	0
Needles	3	1999	2000	2004	5	1	0.95	0	1	0	0	C14	1
Choline chloride	3	1998	1998	2004	6	0	0.76	1	1	1	0	C20	0
MCAA	4	1999	1999	2005	15	0	0.96	1	1	1	0	C20	0
Thread	10	1996	2000	2005	12	1	0.87	0	1	1	1	C13	0
EMC													0
Raw Tobacco IT	4	2002	2002	2005	6	0	0.56	0	1	1	1	G46	0
Industrial bags	16	2001	2001	2005	21	0	0.75	0	1	1	1	C22	0
Rubber chemicals	4	2002	2002	2005	6	0	0.58	1	1	1	0	C20	0
Perborate	9	2000	2000	2006	7	0	0.96	0	1	1	0	C20	0
Methacrylates	5	2002	2002	2006	6	1	0.87	0	0	1	0	C22	0
Bitumen NL	14	2002	2002	2006	8	1	1.00	0	0	1	1	C20	0

Fittings	11	2001	2001	2006	15	0	0.95	0	1	1	1	C33	1
Butadiene Rubber	6	2002	2003	2006	7			0	1	1	0	C20	0
Alloy surcharge		1994	1997	2006	1			0	0	1	0	C.24	0
Elevators	5	2004	2004	2007	9	0	0.86	1	1	0	1	C28	0
NL beer	4	1999	1999	2007	4	0	0.90	0	1	1	0	C11	1
Fasteners	6	1999	2001	2007	10	0	0.97	0	1	0	0	C14	1
Bitumen ES	5	2002	2002	2007	12	1	0.91	1	1	1	1	C19	0
Videotape	3	2002	2002	2007	3	0	0.89	0	0	1	1	C26	0
Flat glass	4	2005	2005	2007	1	0	0.80	0	0	1	0	C23	0
Chloroprene Rubber	6	2000	2002	2007	9	0	0.89	1	1	1	0	C17	0
Nitrile Rubber	2	2000	2002	2008	9	0	0.89	1	1	1	0	C17	0
Removal services	11	2003	2003	2008	19	0	0.50	0	1	0	1	H52	1
Deep-sea transport													0
Sodium chlorate	5	2000	2003	2008	5	0	0.93	1	1	1	0	C20	0
Aluminium fluoride	5	2000	2005	2008	1	0		1	1	1	0	C20	0
Candle waxes	10	2005	2005	2008	13	1	0.75	0	1	1	0	C20	0
Bananas	3	2002	2005	2008	3	0	0.43	0	0	1	0	A01	1
Carglass	4	2003	2005	2008	5	1	0.93	0	1	0	1	C29	0
Marine hoses	6	2007	2007	2009	21	1	0.92	1	1	1	1	C22	0
Printers (EFIM complaint)													1
E.On - GdF	3	2005	2006	2009	26		1.00	0	1	0	0	D35	0
Carbide and magnesium	8	2007	2007	2009	3	0	0.80	0	1	1	0	C20	0
Power transformers	7	2003	2004	2009	4	0		0	1	0	0	C27	0
Heat stabilisers	11	2000	1999	2009	13	0	0.90	1	1	1	0	C20	0
DRAMS	10	2002	2002	2010	4	0	0.93	1	0	1	0	C26	1
Bathroom fittings	17	2004	2004	2010	12			0	0	1	0	C23	1
Pre-stressing steel	17	2002	2002	2010	18	0	0.84	1	1	1	1	C24	0
Animal phosphates	6	2003	2003	2010	35	0	0.69	1	1	1	0	C20	0
Airfreight	14	2006	2006	2010	6		0.22	0	0	1	0	H51	0
LCD	6	2006	2006	2010	4	0	0.82	0	0	1	0	C26	1
Consumer detergents	3	2005	2008	2011	2			0	0	1	0	C20	1
Exotic fruit	2	2005	2005	2011	1	0	0.50	0	0	1	0	A01	1
CRT glass bulbs	4	2004	2009	2011	4	0		0	0	1	0	C23	0
Refriger compressors	5	2007	2009	2011	4	0		0	1	1	0	C28	0
Freight forwarding	15	2007	2007	2012	4			0	0	1	0	H53	1
Mountings windows	9	2007	2007	2012	7			0	0	1	0	C25	1
Water management	3	2008	2008	2012	2			0	0	1	0	C25	1
TV and PC tubes	8	2006	2007	2012	9			0	1	1	0	C26	1
BR/ESBR recidivism			2003										
Automotive wire	5	2009	2010	2013	9	1		1	0	1	0	C29	0
Shrimps	4	2009	2009	2013	9	0	0.85	0	1	1	0	G46	0
Euro rate derivatives	8	2008	2011	2013	3	0		0	0	1	0	K64	1
Yen rate derivatives	6	2010	2010	2013	4	0		0	0	1	0	K64	1
Polyurethane foam	4	2010	2010	2014	5	0		0	0	1	0	C31	0
Power exchanges	2	2012	2012	2014	1	0		0	1	0	0	D35	0
Automotive bearings	6	2011	2011	2014	7	0		1	0	1	0	C28	0
Steel abrasives	4	2010	2010	2014	7	0		1	0	1	0	C23	0
Power cables	26	2009	2006	2014	10	0		0	1	0	0	C27	0
Mushrooms	3	2012	2012	2014	2	0		0	1	1	0	C10	0
Smart card chips	4	2005	2008	2014	2	0		0	1	1	0	C26	0
Swiss Franc rate deriv	4	2007	2011	2014	0	0		0	0	1	0	K66	1
Envelopes	5	2008	2010	2014	5	0		0	1	1	1	C17	1
Parking heaters	2	2011	2013	2015	10	0		0	1	1	0	C29	0
Food packaging	10	2008	2008	2015	8	0		0	1	1	1	C22	0
Car battery	5		2012	2015	3	0		0	0	1	0	E38	1
Blocktrains	3	2012	2013	2015	8	0		0	1	1	0	H49	0
Cement related products			2008	2015								C23	1
Optical disc drives	8	2008	2009	2015	5	0		0	0	0	1	C26	1
Gas switchgear	2	2007	2012	2012	16	0		0	1	0	0	C27	0

Table 10: Comparison with Aguzzoni et al (2013)

firm	cartel	date detection	date decision	% CAR detection	% CAR detection Aguz- zoni et al	% CAR decision	% CAR decision Aguz- zoni et al	fine over mk cap	fine over mk cap Aguz- zoni et al
1	john deere		04/03/92			-0.62			
2	ford		04/03/92			-0.46		0.00	
3	deutz		04/03/92			-2.07		0.00	
4	fiat		04/03/92			0.66		0.00	
5	maureletprom		01/04/92			1.86		0.00	
6	leifhoegh		01/04/92			-3.42		0.03	
7	eastasiatic		01/04/92			0.41		0.01	
8	evergreen		01/04/92			0.67		0.00	
9	british steel	16/01/91	16/02/94	-0.59		-2.10	1.10	1.10	
10	cockerill-sambre	16/01/91	16/02/94	-1.41					
11	krupp hoesch	16/01/91	16/02/94	3.63		1.81	0.00	0.00	
12	norsk jernverk	16/01/91	16/02/94	-0.13		1.43	0.00	0.00	
13	peine-salzgitter	16/01/91	16/02/94	3.54		9.93	0.00	0.00	
14	preussag	16/01/91	16/02/94			0.00			
15	ssab	16/01/91	16/02/94	8.77		-1.66	0.00	0.00	
16	thyssen	16/01/91	16/02/94	-0.21		0.20			
17	cascaades	23/04/91	13/07/94	-2.91		-0.16		3.83	
18	stora	23/04/91	13/07/94	1.81		-1.09		1.68	
19	sca holding	23/04/91	13/07/94	-0.87	2.86	0.70	13.78	0.02	0.27
20	bpb	23/04/91	13/07/94	0.45		-1.39		0.11	
21	mayr melnhof	23/04/91	13/07/94			-3.58		4.07	
22	edison/ausimont	21/11/83	27/07/94			1.52		1.42	
23	ici	21/11/83	27/07/94			-0.27	4.04	0.04	0.03
24	shell	21/11/83	27/07/94			-1.41	-1.86	0.00	0.00
25	norskhydro	21/11/83	27/07/94			-0.32	7.24	0.00	0.03
26	solvay	21/11/83	27/07/94			5.25	2.45	0.11	0.15
27	basf	21/11/83	27/07/94			-0.51	-2.13	0.02	0.02
28	hoechst	21/11/83	27/07/94			-3.35	-4.91	0.02	0.02
29	dsm	21/11/83	27/07/94			-0.95		0.03	
30	enichem	21/11/83	27/07/94			0.59			
31	cementir	01/04/89	30/11/94			2.51	11.67	4.46	4.49
32	dyckerhoff	01/04/89	30/11/94			-3.05	-6.60	2.66	1.45
33	italcementi	01/04/89	30/11/94			2.94	8.83	3.71	2.79
34	holderbank	01/04/89	30/11/94			0.27		0.51	
35	ciments francais	01/04/89	30/11/94			-5.61	-3.71	4.17	4.22
36	cimpor-cimentos pt	01/04/89	30/11/94			-2.08		0.80	
37	heracles cement	01/04/89	30/11/94			-5.61		1.66	
38	fratellibuzzis.p.a.	01/04/89	30/11/94			-0.75		1.53	
39	vicats.a.	01/04/89	30/11/94			2.09		1.32	
40	lafarge	01/04/89	30/11/94			-0.14	-6.57	0.45	0.47
41	bluecircle plc	01/04/89	30/11/94			1.61		0.72	
42	heidelberg	01/04/89	30/11/94			2.29	-6.65	0.71	0.69
43	titan cement company		30/11/94			-2.76	-6.57	2.63	2.26
*	buzzi unicem		30/11/94				-6.77		1.31
44	the rugby group plc	01/04/89	30/11/94			-0.01		0.65	
45	vicats.a.	01/04/89	30/11/94			2.09		1.32	
46	evergreen		21/12/94			-6.09		0.00	
47	p&co nedlloyd		21/12/94			0.54		0.00	
48	mitsui osk lines		21/12/94			2.59	-8.99	0.00	0.00
49	ap moeller-maersk		21/12/94			4.00		0.00	
50	malaysian shipping		21/12/94			-1.79		0.00	
51	neptune orient lines		21/12/94			0.87	0.79	0.00	0.00
52	nippon yusen		21/12/94			-1.18	-5.72	0.00	0.00
53	orient overseas		21/12/94			-1.79	3.49	0.00	0.00
54	hapag lloyd		21/12/94			-1.06		0.00	
55	kawasaki		21/12/94			0.00	-6.73	0.00	0.00
56	p&co nedlloyd	06/04/93	30/10/96	0.78		1.54		0.01	
*	thyssenkrupp		21/01/98				-6.12		0.13
57	acerinoxsa		21/01/98			0.48	-4.02	0.21	0.22
58	hyundai		16/09/98			2.93	-6.37	0.00	8.46
59	nippon yusen		16/09/98			-0.18	3.06	0.00	0.64
60	p&co nedlloyd		16/09/98			-4.57	-31.88	13.41	14.28
61	ap moeller-maersk		16/09/98			3.89	-10.18	0.13	0.50
62	neptune orient lines		16/09/98			-11.12	-11.6	4.79	4.49
63	hanjin		16/09/98			-4.08	-15.44	0.09	65.89
64	orient overseas		16/09/98			0.29	-14.44	1.48	13.08
65	tate and lyle	27/05/94	14/10/98		-10.43	-8.98	-8.95	0.51	0.35
66	minoan	05/07/94	09/12/98			-3.46	-8.24	0.71	0.7
67	dalmine	01/12/94	08/12/99	4.99		-0.32		4.75	
68	kawasaki	01/12/94	08/12/99	-1.25		4.04		0.01	
69	british steel	01/12/94	08/12/99	0.67		3.71		0.32	
*	sumitomo metal	01/12/94	08/12/99		-16.81		4.17		0.42
70	vallourec	01/12/94	08/12/99	-5.53		-3.08	-4.46	2.23	2.23
71	nippon steel	01/12/94	08/12/99	-4.82	-8.47	0.40	-6.66	0.15	0.08
72	yangming		16/05/00			-4.17		0.00	

153	carbone lorraine	carbon and graphite		03/12/03			-12.81	-18.41	12.88	12.91
154	akzo	organic peroxyde		10/12/03			-2.92	6.21	0.00	0.00
155	outokumpu	indust. copper tubes	22/03/03	16/12/03	-19.38		1.72		0.99	
*	kme	indust. copper tubes	22/03/03	16/12/03		14.73		-7.80		8.25
154	boliden	copper plumbing tubes	22/03/01	03/09/04	5.25		-5.69		-5.69	
*	kme	copper plumbing tubes	22/03/01	03/09/04		-5.04		6.49		21.25
155	outokumpu	copper plumbing tubes	22/03/01	03/09/04	-19.38	-20.57	-1.69	-5.09	1.52	1.52
156	mueller	copper plumbing tubes	22/03/01	03/09/04	1.42		3.92		0.00	
157	halcor	copper plumbing tubes	22/03/01	03/09/04	-0.77	-4.15	-2.86	-1.94	5.36	5.28
158	imi	copper plumbing tubes	22/03/01	03/09/04	-2.62		0.21		3.51	
159	heineken	french beer	25/01/00	29/09/04	5.77	18.16	-0.89	0.85	0.01	0.01
*	danone	french beer	25/01/00	29/09/04		-0.10		-6.08		0.01
160	kronenbourg	french beer	25/01/00	29/09/04	-3.16		0.26		0.04	
161	coats	needles	07/11/01	26/10/04	1.10		-4.05		2.81	
162	basf	animal feed		09/12/04			-0.91	5.6	0.12	0.12
163	ucb	animal feed		09/12/04			0.20	8.79	0.17	0.18
164	akzo	animal feed		09/12/04			2.24	1.34	0.23	0.23
165	hoechst	monochloroacetic	14/03/00	19/01/05	4.94		0.33		0.14	
166	akzo	monochloroacetic	14/03/00	19/01/05	7.86		-0.59		0.91	
167	clariant	monochloroacetic	14/03/00	19/01/05	-2.15		0.92		0.00	
168	coats	industrial thread	07/11/01	14/09/05	1.10		6.17		1.02	
169	dimon	raw tobacco italy	18/04/02	20/10/05	-6.86	8.74	-5.16	-23.02	3.40	4.27
170	low & bonar	industrial bags	26/06/02	30/11/05	-1.99	-22.52	11.03	10.55	9.65	6.22
171	british polythene	industrial bags	26/06/02	30/11/05	1.26	13.05	2.98	6.71	0.00	0.00
172	kendrion	industrial bags	26/06/02	30/11/05	-6.63	-12.59	-11.79	-31.57	19.69	21.76
*	trioplast	industrial bags	26/06/02	30/11/05		-21.26		-2.72		1.44
173	nordenia int.	industrial bags	26/06/02	30/11/05	-0.06					
174	upm-kymmene	industrial bags	26/06/02	30/11/05	-6.27	-11.84	0.38	0.11	0.68	0.67
175	sachsa verpackung	industrial bags	26/06/02	30/11/05	-3.29	-8.35	0.41	11.43	10.71	10.92
176	chemtura	rubber chemicals	26/09/02	21/12/05	-1.24					
177	bayer	rubber chemicals	26/09/02	21/12/05	0.26	2.31	2.82	0.43	0.23	0.23
178	akzo	hydrogen peroxide	25/03/03	03/05/06	-2.59	14.03	0.28	2.91	0.61	0.19
179	solvay	hydrogen peroxide	25/03/03	03/05/06	-3.28	5.99	0.81	8.25	2.16	2.11
180	fmc corporation	hydrogen peroxide	25/03/03	03/05/06	0.73	7.89	2.51	3.56	1.00	1.25
181	air liquide	hydrogen peroxide	25/03/03	03/05/06	-0.27		-0.33		0.00	
182	kemira	hydrogen peroxide	25/03/03	03/05/06	0.35	7.09	-1.30	-6.39	1.85	1.89
183	edison/ausimont	hydrogen peroxide	25/03/03	03/05/06	0.96		-2.76	1.51	29.04	0.85
184	degussa	hydrogen peroxide	25/03/03	03/05/06	-1.65		-1.15		0.00	
185	degussa	acrylic glass	25/03/03	31/05/06	-1.65		1.28		0.00	
186	ici	methacrylate	25/03/03	31/05/06	-50.46		-2.02		2.13	
187	barlo	methacrylate	25/03/03	31/05/06	7.40					
188	shell	bitumen netherlands	01/10/02	13/09/06	2.63	4.42	-2.52	-12.94	0.22	0.06
189	koninklijke bam	bitumen netherlands	01/10/02	13/09/06	3.56		-4.77		0.81	
190	wintershall	bitumen netherlands	01/10/02	13/09/06			-0.02			
191	heijmans	bitumen netherlands	01/10/02	13/09/06	-2.22	5.54	-1.95	-16.84	1.87	1.89
*	total	bitumen netherlands	01/10/02	13/09/06		-11.17		-19.96		0.78
*	bam	bitumen netherlands	01/10/02	13/09/06		6.59		-8.10		0.02
192	bp	bitumen netherlands	01/10/02	13/09/06	-2.14	-9.69	-0.10	-7.72	0.00	0.00
193	ballast nedam	bitumen netherlands	01/10/02	13/09/06	20.04		-3.38		1.58	
194	aalberts	copper fittings	22/03/01	20/09/06	-6.73	-9.01	-7.11	-14.71	6.87	7.00
195	legris	copper fittings	22/03/01	20/09/06	0.59					
196	tomkins	copper fittings	22/03/01	20/09/06	-6.30		-3.58		0.26	
197	mueller	copper fittings	22/03/01	20/09/06	1.42	13.57	-0.34	-27.92	0.00	0.00
198	imi	copper fittings	22/03/01	20/09/06	-2.62	-11.15	1.31	4.34	2.91	1.94
199	alstom	gas-insulated	11/05/04	24/01/07	-11.74	-41.58	-4.13	-15.21	0.48	0.49
200	areva	gas-insulated	11/05/04	24/01/07	-0.69	-9.68	2.00	12.11	6.17	0.25
201	hitachi	gas-insulated	11/05/04	24/01/07	-1.92	-0.46	5.94	10.94	0.01	0.29
202	schneider	gas-insulated	11/05/04	24/01/07	-1.69	2.75	-0.22	8.5	0.04	0.04
203	abb	gas-insulated	11/05/04	24/01/07	1.34	-8.46	0.82	-4.21	0.00	0.00
204	fuji electric	gas-insulated	11/05/04	24/01/07	-2.51	3.22	-7.57	-19.96	0.00	0.13
205	toshiba	gas-insulated	11/05/04	24/01/07	-1.60	1.6	-0.16	-8.86	0.00	0.55
206	mitsubishi	gas-insulated	11/05/04	24/01/07	12.14	-4.73	5.83	-4.91	0.00	0.79
207	siemens	gas-insulated	11/05/04	24/01/07	0.80	-1.87	6.16	9.09	0.58	0.54
208	hitachi	gas-insulated	11/05/04	24/01/07			5.94		0.01	
209	mitsubishi	elevators/escalators	28/01/04	21/02/07	-1.85		2.38		0.00	
210	thyssen	elevators/escalators	28/01/04	21/02/07	-2.43	-5.22	-0.51	5.45		2.38
211	otis	elevators/escalators	28/01/04	21/02/07	1.64	-6.47	-1.75	1.79	0.33	0.44
212	schindler	elevators/escalators	28/01/04	21/02/07	-5.29	-0.65	5.26	-6.07	2.32	2.27
213	kone	elevators/escalators	28/01/04	21/02/07	-3.01	-5.22	-0.69	5.45	2.80	2.38
214	heineken	netherlands beer	13/07/99	18/04/07	-0.43	14.12	0.74	-1.38	1.16	1.14
215	inBev nv	netherlands beer	13/07/99	18/04/07			-0.18	-6.06	0.00	0.00
216	bavaria nv	netherlands beer	13/07/99	18/04/07	1.78					
217	grolsch nv	netherlands beer	13/07/99	18/04/07	-1.60					
218	coats	fasteners	07/11/01	19/09/07	1.10		-4.33		8.41	
219	repso	spain bitumen	01/10/02	03/10/07	1.26		0.14	-11.28	0.26	0.26
220	bp	spain bitumen	01/10/02	03/10/07	-2.14		-1.24	5.5	0.00	0.00
221	galp energia	spain bitumen	01/10/02	03/10/07			-0.68	-2.53	0.10	0.10
222	cepsa	spain bitumen	01/10/02	03/10/07	-1.50		1.58	-1.16	0.45	0.44
223	fuji electric	professional videotapes	28/05/02	20/11/07	4.11	-4.52	-2.72	5.66	0.00	3.44
224	sony	professional videotapes	28/05/02	20/11/07	-2.50	2.86	0.72	19.07	0.00	0.14
225	maxell	professional videotapes	28/05/02	20/11/07	5.03		-0.69		0.01	
226	asahi	flatglass	22/02/05	28/11/07	-0.86	-3.43	4.93	2.36	0.00	0.58
227	pilkington	flatglass	22/02/05	28/11/07	0.31	0.92	0.22	-21.87	280.50	5.74
228	saint gobain	flatglass	22/02/05	28/11/07	-2.08	-5.17	1.36	-0.97	0.52	0.53
229	bayer	chloroprene	27/03/03	04/12/07	2.34	18.94	2.02	2.80	0.00	0.00

230	denka	chloroprene	27/03/03	04/12/07	0.50	-16.77	-4.06	-26.9	0.13	2.89
231	tosoh	chloroprene	27/03/03	04/12/07	-4.37	-13.2	-5.52	-36.61	0.00	0.25
232	dupont	chloroprene	27/03/03	04/12/07	-0.07	0.44	1.19	-5.88	0.11	0.20
233	dow chemical	chloroprene	27/03/03	04/12/07	1.10	-1.23	-0.59	-2.72	0.01	0.02
234	eni	chloroprene	27/03/03	04/12/07	-0.59		1.52	4.09	0.13	0.13
235	zeon	nitrile butadiene	27/03/03	23/01/08	1.16	17.68	1.91	9.90	0.00	0.56
236	bayer	nitrile butadiene	27/03/03	23/01/08	2.34	18.94	-2.84	-0.30	0.07	0.07
237	exel	removal service	16/09/03	11/03/08	-1.14		-3.68		0.04	
*	uralita	removal service		11/06/08				-3.19		0.86
238	akzo	sodium chlorate		10/06/08			-2.32		0.00	
239	aragonesas	sodium chlorate		10/06/08			1.94		0.37	
240	boliden	aluminium fluoride	25/05/05	25/06/08	1.78		6.88		0.00	
241	exxon mobil	parafin wax	28/04/05	01/10/08	-4.70	-11.18	4.45	3.33	0.02	0.03
242	eni	parafin wax	28/04/05	01/10/08	0.67	1.37	-0.74	-21.12	0.04	0.04
243	rwe	parafin wax	28/04/05	01/10/08	2.66	1.31	1.34	-11.67	0.10	0.10
*	total	parafin wax	28/04/05	01/10/08		-0.68		-13.67		0.13
244	repsol	parafin wax	28/04/05	01/10/08	-1.16	-3.67	-3.99	-10.30	0.08	0.08
245	mol	parafin wax	28/04/05	01/10/08	-1.35	10.11	2.72	9.25	0.00	0.34
246	hansen & rosenthal	parafin wax	28/04/05	01/10/08	-0.82		-8.06		5.36	
247	sasol	parafin wax	28/04/05	01/10/08	0.25	7.09	-5.06	-19.29	0.14	1.77
248	shell	parafin wax	28/04/05	01/10/08	-0.51	1.93	-3.19	1.39	0.00	0.00
249	del monte / weichert	banana	02/06/05	15/10/08		-12.67	-2.11	12.92	1.65	1.99
250	pilkington	car glass	22/02/05	12/11/08	0.31	0.92	1.14	-51.57	803.39	21.22
251	asahi	car glass	22/02/05	12/11/08	-0.86	-3.43	-3.66	-18.74	0.02	2.24
252	saint gobain	car glass	22/02/05	12/11/08	-2.08	-5.17	-3.00	-21.79	8.17	8.33
253	dunlop oil & marine	marine hoses	02/05/07	28/01/09	1.81	-0.69	-6.33	-36.66	0.77	0.83
254	trellborg	marine hoses	02/05/07	28/01/09	0.48	6.44	6.59	-8.06	0.65	6.39
*	parker itr	marine hoses	02/05/07	28/01/09		3.45		8.87		0.53
255	bridgestone	marine hoses	02/05/07	28/01/09	2.03	5.9	1.00	-4.94	0.01	0.7
256	yokohama	marine hoses	02/05/07	28/01/09	0.00	10.82	-2.37	-30.76	0.00	0.00
257	e.on ag	Distribution of gas	16/05/06	08/07/09	-5.53					
258	skwstahl-metallurgie	calcium carbide	16/01/07	22/07/09			-10.30		23.06	
259	akzo	calcium carbide	16/01/07	22/07/09	-0.18		2.27	8.39	0.00	0.00
260	hitachi	power transformers	11/05/04	07/10/09	-1.92	0.03	-2.19	1.62	0.00	2.46
261	fuji electric	power transformers	11/05/04	07/10/09	-2.51	0.18	4.08	-4.43	0.00	1.73
262	toshiba	power transformers	11/05/04	07/10/09	-1.60	0.09	6.05	6.50	0.00	13.20
263	siemens	power transformers	11/05/04	07/10/09	0.80	0	0.76	0.27	0.00	0.00
264	areva	power transformers	11/05/04	07/10/09	-0.69	0.05	-0.99	-10.72	2.47	6.77
265	abb	power transformers	11/05/04	07/10/09	1.34	0.1	2.13	2.69	0.07	33.75
266	alstom	power transformers	11/05/04	07/10/09	-11.74	0.07	1.51	-3.83	0.12	9.38
267	elementis	heat stabilisers	12/02/03	11/11/09	-1.37		-17.47		13.89	
268	gea	heat stabilisers	12/02/03	11/11/09	-0.23		0.82		0.13	
269	akzo	heat stabilisers	12/02/03	11/11/09	-4.93		2.33		0.40	
270	basf	heat stabilisers	12/02/03	11/11/09	-1.45		1.83		0.19	
271	chemtura	heat stabilisers	12/02/03	11/11/09	1.13		-12.32		0.00	
272	infineon	drams		19/05/10			-6.30		1.08	
273	hitachi	drams		19/05/10			-1.52		0.01	
274	elpida	drams		19/05/10			-4.17		0.00	
275	nec	drams		19/05/10			-2.92		0.00	
276	nanya	drams		19/05/10			-3.53		0.00	
277	hynix	drams		19/05/10			-2.39		0.00	
278	samsung	drams		19/05/10			0.21		0.00	
279	toshiba	drams		19/05/10			-1.42		0.00	
280	micron	drams		19/05/10			7.75		0.00	
281	mitsubishi	drams		19/05/10			1.10		0.00	
282	masco	bathroom fittings	09/11/04	23/06/10	-1.01		1.45		0.00	
283	v & b	bathroom fittings	09/11/04	23/06/10	0.93		-17.18		126.58	
284	sanitec	bathroom fittings	09/11/04	23/06/10	-2.08					
285	austria draht	prestressing steel	19/09/02	30/06/10	-4.75		-0.69		0.58	
286	arcelormittal	prestressing steel	19/09/02	30/06/10	-6.62					
287	kemira	feed phosphates	10/02/04	20/07/10	-4.11		-4.31		0.00	
288	ercros	feed phosphates	10/02/04	20/07/10	-1.44		-5.02		19.56	
289	fmc corporation	feed phosphates	10/02/04	20/07/10	4.06		0.11		0.33	
290	tessengerlo chemie	feed phosphates	10/02/04	20/07/10	-1.40		-2.00		13.16	
291	sas	airfreight	14/02/06	09/11/10	-5.62		-6.36		0.80	
292	qantas	airfreight	14/02/06	09/11/10	-0.54		-0.42		0.14	
293	lanchile	airfreight	14/02/06	09/11/10	4.12		-2.46		0.00	
294	lufthansa	airfreight	14/02/06	09/11/10	3.80		-1.84		0.00	
295	aircanada	airfreight	14/02/06	09/11/10			-7.34		2.78	
296	singapore airlines	airfreight	14/02/06	09/11/10	1.08		-0.57		0.38	
297	air france	airfreight	14/02/06	09/11/10	3.05		-1.88		4.42	
298	cathay	airfreight	14/02/06	09/11/10	2.20		1.61		0.07	
299	japanairlines	airfreight	14/02/06	09/11/10	0.12					
300	klm	airfreight	14/02/06	09/11/10	3.05					
301	hann star	lcd		08/12/10			3.75		0.03	
302	chunghwa	lcd		08/12/10			-0.94		0.00	
303	samsung	lcd		08/12/10			1.48		0.00	
304	lg display	lcd		08/12/10			-1.84		0.00	
305	au optronics	lcd		08/12/10			-1.29		0.04	
306	henkel	consumer detergents		13/04/11			-2.80		0.00	
307	unilever	consumer detergents		13/04/11			3.17		0.29	
308	p & g	consumer detergents		13/04/11			2.25		0.11	
309	chiquita	exotic fruit	28/11/07	12/10/11			2.59		0.00	
310	asahi	carglass		19/10/11			-4.07		0.01	
311	samsung	carglass		19/10/11			4.99		0.00	

312	nippon electric	carglass		19/10/11		-5.28	0.01
313	embraco/whirlpool	refrigeration		07/12/11		1.23	1.45
314	panasonic	refrigeration		07/12/11		-0.80	0.00
315	tecumseh	refrigeration		07/12/11		-3.94	0.00
316	uti worldwide	freight forwarding	10/10/07	28/03/12	-1.95	1.74	0.18
317	toll global	freight forwarding	10/10/07	28/03/12	-1.86	-0.57	0.07
318	exel	freight forwarding	10/10/07	28/03/12	2.84	0.36	0.00
319	agility logistics limited	freight forwarding	10/10/07	28/03/12	-0.36	0.31	1.19
320	panalpina	freight forwarding	10/10/07	28/03/12	-5.59	0.25	1.92
321	ups	freight forwarding	10/10/07	28/03/12	-0.10	-0.26	0.02
322	beijing kintetsu	freight forwarding	10/10/07	28/03/12	-2.90	1.45	0.00
323	nippon express	freight forwarding	10/10/07	28/03/12	-4.21	0.02	0.00
324	dsv	freight forwarding	10/10/07	28/03/12	-6.12	0.90	0.00
325	expeditors	freight forwarding	10/10/07	28/03/12	-0.89	0.32	0.04
326	kuehne	freight forwarding	10/10/07	28/03/12	-1.60	0.10	0.37
327	pneumatex	water management		27/06/12		-5.59	0.00
328	sumitomo electric	auto. wire harnesses		10/07/13		-1.43	
329	furukawa electric	auto. wire harnesses		10/07/13		-2.91	
330	recticel nv/sa	polyurethane foam	27/07/10	29/01/14	5.10		
331	safransa	power cables	28/01/09	02/04/14	-1.38		
332	goldman sachs	power cables	28/01/09	02/04/14	10.32		
333	nexanssa	power cables	28/01/09	02/04/14	3.07		
334	sumitomo electric	power cables	28/01/09	02/04/14	5.63		
335	pirelli & c.s.p.a.	power cables	28/01/09	02/04/14	-0.74		
336	bonduelle sas	mushrooms	28/02/12	25/06/14	1.33		
337	jpmorgan chase & co	yen interest rate deriv.	04/12/13	21/10/14		-0.61	0.04
338	ub sag	yen interest rate deriv.	04/12/13	21/10/14		0.20	0.00
339	bank of scotland	yen interest rate deriv.	04/12/13	21/10/14		2.34	1.27

REFERENCES

- Aguzzoni, Luca, Gregor Langus, and Massimo Motta**, “The effect of EU antitrust investigations and fines on a firm’s valuation,” *The Journal of Industrial Economics*, 2013, 61 (2), 290–338.
- Alexander, Cindy R**, “On the nature of the reputational penalty for corporate crime: evidence,” *The Journal of Law and Economics*, 1999, 42 (S1), 489–526.
- Amiri, Hadi and Tat-Seng Chua**, “Sentiment classification using the meaning of words,” in “Workshops at the Twenty-Sixth AAAI Conference on Artificial Intelligence” 2012.
- Armour, John, Colin Mayer, and Andrea Polo**, “Regulatory sanctions and reputational damage in financial markets,” *Journal of Financial and Quantitative Analysis*, 2017, 52 (4), 1429–1448.
- Baccianella, Stefano, Andrea Esuli, and Fabrizio Sebastiani**, “SentiWordNet 3.0: An enhanced lexical resource for sentiment analysis and opinion mining,” in “LREC,” Vol. 10 2010, pp. 2200–2204.
- Brown, Stephen J and Jerold B Warner**, “Measuring security price performance,” *Journal of Financial Economics*, 1980, 8 (3), 205–258.
- _____ and _____, “Using daily stock returns: The case of event studies,” *Journal of Financial Economics*, 1985, 14 (1), 3–31.
- Campbell, Cynthia J, Arnold R Cowan, and Valentina Salotti**, “Multi-country event-study methods,” *Journal of Banking and Finance*, 2010, 34 (12), 3078–3090.
- de Kauter, Marjan Van, Diane Breesch, and Véronique Hoste**, “Fine-grained analysis of explicit and implicit sentiment in financial news articles,” *Expert Systems with Applications*, 2015, 42 (11), 4999–5010.
- Esuli, Andrea and Fabrizio Sebastiani**, “Sentiwordnet: A publicly available lexical resource for opinion mining,” in “Proceedings of LREC,” Vol. 6 2006, pp. 417–422.
- Fama, Eugene F**, “The behavior of stock-market prices,” *The Journal of Business*, 1965, 38 (1), 34–105.
- Gonçalves, Carlos Adriano, Célia Talma Gonçalves, Rui Camacho, and Eugénio C Oliveira**, “The impact of pre-processing on the classification of MEDLINE documents,” in “PRIS” 2010, pp. 53–61.
- Gupta, Vishal and Gurpreet S Lehal**, “A survey of text mining techniques and applications,” *Journal of Emerging Technologies in Web Intelligence*, 2009, 1 (1), 60–76.
- Hamouda, Alaa and Mohamed Rohaim**, “Reviews classification using sentiwordnet lexicon,” in “World Congress on Computer Science and Information Technology” 2011.
- Hotho, Andreas, Andreas Nürnberger, and Gerhard Paaß**, “A Brief Survey of Text Mining,” in “Ldv Forum,” Vol. 20 2005, pp. 19–62.
- Iacobucci, Edward**, “On the interaction between legal and reputational sanctions,” *Journal of Legal Studies*, 2014, 43, 189–207.
- Jarrell, Gregg and Sam Peltzman**, “The impact of product recalls on the wealth of sellers,” *Journal of Political Economy*, 1985, 93 (3), 512–536.
- Jones, Kari and Paul H Rubin**, “Effects of harmful environmental events on reputations of firms,” in “Advances in Financial Economics,” Emerald Group Publishing Limited, 2001, pp. 161–182.
- Jr, John R Lott**, “Brand names, ignorance, and quality guaranteeing premiums,” *Applied Economics*, 1988, 20 (2), 165–176.
- Kahneman, Daniel and Amos Tversky**, “Judgment under uncertainty: Heuristics and biases,” *Science*, 1974, 185 (4157), 1124–1131.
- Karpoff, Jonathan M and John R Lott Jr**, “Reputational penalty firms bear from committing criminal fraud, the,” *Journal of Law and Economics*, 1993, 36, 757.
- _____, **D Scott Lee, and Gerald S Martin**, “The consequences to managers for financial misrepresentation,” *Journal of Financial Economics*, 2008, 88 (2), 193–215.
- _____, **John R Lott Jr, and Eric W Wehrly**, “The reputational penalties for environmental violations: Empirical evidence,” *Journal of Law and Economics*, 2005, 48 (2), 653–675.

- Kaspereit, Thomas**, “EVENTSTUDY2: Stata module to perform event studies with complex test statistics,” 2016.
- Klein, Benjamin and Keith B Leffler**, “The role of market forces in assuring contractual performance,” *The Journal of Political Economy*, 1981, pp. 615–641.
- Kolari, James W and Seppo Pynnönen**, “Event study testing with cross-sectional correlation of abnormal returns,” *Review of Financial Studies*, 2010, *23* (11), 3996–4025.
- MacKinlay, A Craig**, “Event studies in economics and finance,” *Journal of Economic Literature*, 1997, *35* (1), 13–39.
- Malkiel, Burton G and Eugene F Fama**, “Efficient capital markets: A review of theory and empirical work,” *The Journal of Finance*, 1970, *25* (2), 383–417.
- Mitchell, Mark L and Michael T Maloney**, “Crisis in the cockpit? The role of market forces in promoting air travel safety,” *The Journal of Law and Economics*, 1989, *32* (2), 329–355.
- Peltzman, Sam**, “The effects of FTC advertising regulation,” *The Journal of Law and Economics*, 1981, *24* (3), 403–448.
- Shapiro, Carl**, “Premiums for high quality products as returns to reputations,” *The Quarterly Journal of Economics*, 1983, pp. 659–679.
- Shiller, Robert James**, “Do stock prices move too much to be justified by subsequent changes in dividends,” *American Economic Review*, 1981, *71*, 421–436.
- Vijayarani, S, Ms J Ilamathi, and Ms Nithya**, “Preprocessing techniques for text mining-an overview,” *International Journal of Computer Science and Communication Networks*, 2015, *5* (1), 7–16.