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**THE EFFECT OF EU ANTITRUST
INVESTIGATIONS AND FINES
ON A FIRM'S VALUATION**

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ABSTRACT

The Effect of EU Antitrust Investigations and Fines on a Firm's Valuation*

We estimate, using event study techniques, the impact of the main events in an antitrust investigation on a firm's stock market value. A surprise inspection at the firm's premises has a strong and statistically significant effect on the firm's share price, with its cumulative average abnormal return being approximately -2%. Further, we find that a negative Decision by the European Commission results in a cumulative average abnormal return of about -3.3%. Overall, the fine accounts for a relatively small fraction of this loss in value. Finally, if the Court annuls or reduces the fine, this has a positive (+2%) effect on the firm's valuation.

JEL Classification: K21, K42 and L4

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1 Introduction

Antitrust laws are fundamental in market economies, as they prevent firms from distorting competition in a way that is detrimental to economic efficiency, and fines are a crucial tool for the enforcement of antitrust laws. Only if the fines, and more generally the costs that firms incur when found guilty of antitrust infringement, are large enough, will the firms be deterred from engaging in cartels and other anti-competitive behaviour.

In the US, managers who have been found guilty of a conspiracy can be given prison sentences, and firms are subject to fines and to the payment of treble damages in private actions. In the EU, which is the object of this study, competition law violators are not subject (at EU level) to criminal penalties, and private damages actions are extremely rare, but firms can in principle be given fines up to 10% of their previous year's turnover.

Yet, anecdotal evidence suggests that the impact of antitrust investigations and fines may not be that large for firms which are caught infringing EU competition law. Indeed, a large number of firms (and in fact some firms from the sample we analyse in this paper) are repeat offenders. Moreover, negative Commission decisions and Community Court judgments do not seem to trigger management changes very often. This raises the question of the extent to which firms are seriously affected by the fines they receive, or expect to receive.

In this paper, we carry out an empirical analysis to explore the effect of antitrust investigations on the share prices of firms which have infringed European competition law. To our knowledge, ours is the first work which tries to estimate the impact of European antitrust investigations on offending firms.¹ In an exercise carried out for the US, Bosch and Eckard (1991) use a similar methodology to estimate the effect on the firm's stock market price of an indictment for price fixing.² They find that the shares of indicted firms in their sample on average lose a cumulative 1.08% of their value in the days immediately after the public announcement of the indictment.³ They estimate that fines and damages account for only 13% of the total loss of stock market value caused by the firm's antitrust indictment.

The main reason why an antitrust investigation may create a loss in the firm's value which goes well beyond the fine is that the firm will likely have

¹For empirical analyses of the effects of EU merger notifications and decisions, which make use of the event study methodology also used here, see Duso, Neven and Röller (2006a) and Duso, Gugler and Yurtoglu (2006b).

²Bizjak and Coles (1995) carry out another event study analysis on US data relative to private antitrust litigation. They find that, on average, defendants lose approximately 0.6 percent of their equity value (and plaintiffs gain less than what defendants lose).

³An indictment by the US Department of Justice should be 'news' to the markets, as the indictment is preceded by investigations which are supposed to be secret. Bosch and Eckard (1991) also check for possible leaks before the indictment takes place and take appropriate steps to deal with them.

to put an end to a profitable activity (be it a cartel, an abusive practice, or any other business practice considered illegal by the antitrust agencies and the courts).^{4,5}

The EU competition law institutional framework, in a nutshell

Since our objective is to analyze the effect of antitrust investigations, it is appropriate to briefly remind the reader of the main actors in the field of EU competition law, and of the main events which occur in a typical investigation. The European Commission is the primary competition authority for the enforcement of EU competition law, whose main provisions are contained in articles 81 and 82 of the Treaty establishing the European Community. Fines can be imposed on firms which have infringed articles 81 or 82, and Regulation 1/2003 (which has replaced Regulation 17/1962, which contained very similar provisions for the purposes of our article) establishes the main rules for the Commission's fining policy: in particular, fines are imposed at the discretion of the Commission, whose decisions are however subject to the review of the Community Courts, i.e. the Court of First Instance (CFI) and the European Court of Justice (ECJ); they can never be higher than 10% of the firm's worldwide turnover in the previous year; they should be proportional to the gravity and duration of the infringements; and they cannot consist of criminal penalties.

In 1998, the Commission published a Notice containing the Guidelines (i.e., a code of practice) that it would follow in deciding fines,⁶ but several commentators still criticise the Commission for a lack of transparency and for exercising too much discretion in its fining decisions.

Note also that the turnover referred to in the Regulation is not necessarily the turnover in the relevant product (and geographic) market involved by the antitrust investigation.⁷

⁴Furthermore, in some cases, the firm may also have to comply with (structural or behavioural) remedies which could lower its profits even more.

⁵Other sources of loss in value, in addition to the direct effect of the fines, could be: (i) legal and consulting fees for antitrust proceedings; (ii) the firm may have to give up profitable projects either because the management is distracted by the antitrust investigations, and/or because, in case of large fines, the firm will have lower retained earnings and cash: in imperfect financial markets, lower assets will limit the firm's ability to obtain credit; and (iii) the firm may be hurt by the negative publicity following an antitrust investigation.

⁶On 28 June 2006, the European Commission slightly revised the Guidelines for setting antitrust fines. However, all the observations in our sample date from before June 2006.

⁷Since relevant market turnover data are typically not published in the Commission Decisions for confidentiality reasons, it is not possible to identify whether the base fine is computed as a percentage of turnover. This should change in the future: the June 2006 Guidelines provide that the base fines may be up to 30% of the company's annual sales in the market to which the antitrust infringement relates, multiplied by the number of years of participation in the infringement, provided the total is within the limit of 10% of the firm's total annual turnover.

However calculated, commentators (and the Commission itself) agree that, until 1979 (with the *Pioneer* Decision, which is also the first Decision in our sample), the Commission was rather lenient when imposing fines.⁸ Table A.1 in the Appendix provides information about the fines given to the firms in our sample: they range from 0 to 497 million euro.⁹

How an antitrust investigation proceeds

The European Commission, or more precisely its Directorate General for Competition (DG-COMP), begins its investigation either at its own initiative or on the basis of a complaint from a third party (although, if complaints occur, the Commission has no obligation to start an antitrust procedure). There is (generally) no announcement that an investigation has started, and no precise time frame for it. If during the preliminary stages the Commission has serious suspicions that there has been an antitrust infringement, it can carry out a surprise inspection, also called a *dawn raid*, on the premises of the firm(s), to gather documentary evidence (which is absolutely crucial for anticompetitive agreement cases, but relevant for abuse cases too).¹⁰ A well-established jurisprudence obliges the Commission to take steps to respect the rights of the defendants during the investigation.¹¹ Among these, the Commission has to send a *Statement of Objections* to the firms under investigation, where it states its allegations regarding the practices of the firm and asks for the firm's response.

After having analyzed all the evidence and having heard from the parties, the Commission will take a *Decision*, which may be reached a long time after the Statement of Objections (in some cases, it may even take a few years). A relevant feature for our analysis is that the Decision is a collegial decision of the whole European Commission, not of DG-COMP, and before the Decision is taken several bodies are consulted, such as representatives of national competition authorities and members of other directorates general. Although all the people involved are bound by confidentiality clauses, leaks about (or speculations on) the content of the Decision and the level of the fines are common.

Firms which have been fined can appeal to the Community Courts, which

⁸See for instance Geradin and David (2005, p. 20 and ff.).

⁹A noteworthy element of the Commission's fining policy is the possibility to grant, under its Leniency Programme, reductions in fines to firms which cooperate in cartel investigations. A zero fine is due to the fact that the Commission can grant a 100% fine reduction to a firm which reports information allowing the Commission to have sufficient evidence to convict firms involved in a cartel. See Motta (2004) for a textbook analysis of leniency programmes.

¹⁰Pursuant to Regulation 1/2003, the Commission can also conduct surprise inspections at the homes (and private vehicles) of firms' managers and employees.

¹¹Indeed, several Commission Decisions have been annulled by the Community Courts on various procedural grounds.

can rule upon the merits of the Commission Decision, and whose *Judgments* can annul, reduce, uphold or even increase the fine (although to our knowledge neither the CFI nor the ECJ has ever increased the Commission's fines), as well as of course annul or uphold, completely or partly, the overall Decision. The last column of Table A.1 in the Appendix summarises the fines as they appeared in the first Court judgments;¹² the penultimate column reports the ratio between the fine and the firm's capitalization.

The decisions taken by the Court are not made public until the moment they are announced, although in some cases there may be signs of the judges' views.¹³

Our approach

We use standard event study methodology to investigate the effect of the antitrust investigation on the firm's share price. More particularly, we try to do so by analyzing the effect of the three main events in the investigation procedure identified above: (i) the dawn raid, (ii) the Commission Decision, and (iii) the Court's judgment.¹⁴ For each of these events there is a precise date on which they occur, even if in some cases it cannot be pinpointed (and when this happens, the observation is dropped). However, surprise inspections do not always take place and firms may decide not to appeal.

Note that these events differ in the extent to which they represent a genuine surprise to investors. In other words, some of the events may have been expected and thus may have already been reflected in the price of the relevant securities before the actual date of the event. In such circumstances, the event dates are not good proxies for the time when the news about the (expected) event reached the market. Thus, our analysis might lead us to reject the null hypothesis of no effect more often than it should be.¹⁵

(i) The surprise inspection, or dawn raid, should represent a genuine surprise for the investors. To verify that this is really an unexpected event, we examined past issues of the *Financial Times* for any news about the (potential) investigation before the inspection took place, and we could not find any, for any of the firms for which we have dates of the raid.¹⁶ Because

¹²In older cases, the firms' appeal was decided by the ECJ. In more recent years, it is the CFI which decides; firms can also appeal the CFI's judgment. We do not look at this 'second' judgment, and only consider the first judgment, whichever Court takes it.

¹³In particular the opinion of the Advocate General often (though not always) anticipates the judgment of the Court. However, Advocates General are only involved in the ECJ's procedures and not the CFI's.

¹⁴We also looked at the effects of the Statement of Objections, but as expected we did not find any significant effect of this event on the value of the firm.

¹⁵In other words, when the news of the event reaches the market it may trigger an effect, but by using the date of the event, which is anticipated by the market, we may not be able to catch this effect.

¹⁶It is of course possible that investors may none the less anticipate that an investigation will take place. This may be the case in particular for some of the international cartel cases

the surprise inspection may allow the Commission to find incriminating evidence and because it is typically done only after the Commission already has some motivated suspicion of infringement, this event is likely to signal that a negative Decision of antitrust infringement will ultimately be taken.¹⁷ Accordingly, a dawn raid should induce investors to revise downwards their valuation of the firm.

(ii) Next, we investigate the effect of the Commission Decision. As explained above, the market has already been aware that the Commission has been investigating the firm since the dawn raid or at least since the Statement of Objections. The investors should therefore be expecting the Decision to be taken at some time.¹⁸ Under the efficient market hypothesis (see Section 2.2), this information should be included in the price so that we do not expect a large systematic under- or over-valuation of the possible effect of the publication of the Decision of the Commission on the value of the firm.

(iii) Finally, we investigate the effect of the Court's judgments, in particular when the judges significantly reduce or annul the fine, which we would expect to have a positive effect on the firm's valuation if it came as a surprise.

The paper continues in the following way. Section 2 describes our data and explains our estimation procedure. Section 3 reports the results of our analysis and discusses their robustness. Section 4 concludes the paper and discusses tentative policy implications.

2 Data and estimation procedure

In this Section, we first describe our data, and then the estimation procedure we follow.

2.1 Data

Our data come from Commission Decisions, published in the Official Journal of the European Communities, and judgments of the Court of First Instance and the European Court of Justice, published in the European Court Reports and other sources. The data refer to all the Decisions resulting in a fine from 1969 until 2005. In the Decisions the Commission describes the

which appear in our sample, where a US antitrust case precedes the EU investigation. We deal with this issue in Section 3.1 below.

¹⁷We were unable to verify in how many cases the firms that were raided were later found not to be guilty and therefore were not subject to any fine, because Decisions are taken only when an infringement is found. If in the course of the investigation the Commission finds no evidence that a firm has violated the law (a rare event after a dawn raid though), there is usually no public announcement that the investigation has ended.

¹⁸By examining past issues of the *Financial Times* we found that the news about the potential threat of a fine is concentrated in a period of a month before the date of the Decision.

investigation and usually reports the date of the surprise inspection, if it was made.

We have retained only decisions involving the firms quoted in a stock exchange for which data on share price are available in the Datastream database.¹⁹ Our final sample refers to 55 decisions (the first of which dates from 1979) involving 88 firms. Some of the firms were repeat offenders.²⁰

Data on share prices are not available for all the firms at the time of the events. For this reason we are forced to drop further observations from our sample. We have exact dates of Commission Decisions and data on the share prices at the time of the Decision for 125 infringements of either article 81 or 82. We also have dates of Court judgments for 69 infringements, as well as exact dates of surprise inspections for 45. However, we assume that stock market operators know the industry well, and can understand that the surprise inspection at the premises of one or more possible participants of a cartel signals a high probability of involvement, and discovery of infringement, also with respect to the other firms that later appear in the decision. Therefore, if we have the date of a surprise inspection for one firm, we assign this date to all the firms that appear in the same cartel case. This way we gain 5 additional observations for the dawn raid.²¹

Table A.1 in the Appendix lists the firms in our sample, and indicates the type of antitrust infringement as well as the dates of the relevant events.

The firms in our sample are quoted on different stock exchanges. The majority are quoted in Frankfurt and Tokyo, followed by New York, London and Paris. The remaining stock exchanges where the firms from our sample are quoted are Amsterdam, Korea, Hong Kong, Singapore, Stockholm, Oslo, Brussels, Copenhagen, Milan, Luxembourg, Taiwan, Malaysia, Athens and Vienna.

2.2 Event Study Methodology and Estimation Procedure

The central concept in the event study methodology is the efficient market hypothesis (EMH). Under this hypothesis, the price of the security reflects the value to investors of all the relevant available information about the

¹⁹We are aware that sample selection is a possible concern of our analysis, to the extent that publicly quoted firms tend to be large, multiproduct, and possibly multinational firms, for which the effect of a fine related to one particular product and geographic market may well be smaller than for a smaller, single-product firm operating in a domestic market. However, it should also be recalled that the Commission can impose fines up to 10% of the total (world) turnover of a firm, and that proportionality is one of the most important criteria in calculating fines, so that other things being equal a larger multiproduct and multinational firm would generally be given a larger fine.

²⁰One of the firms in our sample, BASF, was involved in 5 infringements; 2 firms, Solvay and Bayer were involved in 4 infringements; 7 firms were involved in 3 infringements; 18 in two; and the remaining 60 firms were involved in one infringement.

²¹We have verified that the results are robust to the exclusion of these additional observations.

fundamentals of the firm. Moreover, under the EMH, any news about the fundamentals are immediately reflected in the share price.

The question that the event study attempts to answer is: what is the value of a change of a particular fundamental. Under the EMH, if we knew the exact time in which the news became available to investors and the security price that would have prevailed in the absence of this news we could compute the value of the change of the fundamental that is reflected in the news, as the difference between the counterfactual and the actual price.

We use standard event study methodology to estimate the effect of the three above mentioned events (news about the four events) in the antitrust investigation on the value of the firm. Our main references for the event study methodology are Campbell et al. (1997) and MacKinlay (1997).²²

To obtain a counterfactual return we use a simple market model of returns:²³

$$R_{i\tau} = \alpha_i + \beta_i R_{m\tau} + \epsilon_{i\tau}, \quad (1)$$

where $R_{i\tau}$ and $R_{m\tau}$ are the period- τ returns on security i and the leading index of the stock exchange where the security is quoted, respectively. We compute the returns as $\ln P_{it} - \ln P_{it-1}$, where P_{it} is the price of the share on trading day t .

INSERT FIGURE 1 HERE

Figure 1 illustrates our approach. We define $\tau = 0$ as the event date, $\tau = T_2$ to $\tau = T_3$ form the event window and the periods from $\tau = T_0$ through $\tau = T_1$ form the estimation window. Let $L_1 = T_1 - T_0 + 1$ and $L_2 = T_3 - T_2 + 1$. We estimate parameters α_i and β_i for the firm i security using 101 trading days in the period $T_0 = -120$ to $T_1 = -20$, except in the case of the Commission Decision, where we use the window from $T_0 = -130$ to $T_1 = -30$.²⁴ Then we use the estimated model as the model of counterfactual returns in the periods of interest to construct *abnormal returns* in the event window as

$$\hat{\epsilon}_{i\tau}^* = R_{i\tau}^* - \left(\hat{\alpha}_i + \hat{\beta}_i R_{m\tau}^* \right), \quad (2)$$

²²See also Brown and Warner (1980, 1985).

²³A convenient assumption that we will make is that the $(N \times 1)$ vector of asset returns, R_t , is independently multivariate normally distributed with mean μ and covariance matrix Ω for all t . Under this assumption, given that the model is correctly specified, the abnormal returns, conditionally on the market return, are jointly normally distributed. This result is the basis of our inference.

²⁴In one of the robustness checks we look at a long event window for the Commission Decision (from $T_2 = -25$ to $T_3 = 3$), and we need an estimation window which does not overlap with the event window. We have verified that the results are not sensitive to variations in the estimation window.

where R_i^* and R_m^* are $L_2 \times 1$ vectors of actual returns on the security i and of the leading index of the stock market where i is quoted.

Using the market model, the vector of abnormal returns for the event window for firm i is given by

$$\hat{\epsilon}_i^* = \mathbf{R}_i^* - (\hat{\alpha}_i \iota - \hat{\beta}_i \mathbf{R}_m^*) \quad (3)$$

$$= \mathbf{R}_i^* - \mathbf{X}_i^* \hat{\Theta}_i \quad (4)$$

where \mathbf{R}_i^* is a $(L_2 \times 1)$ vector of event window returns and \mathbf{X}_i^* is a $(L_2 \times 2)$ matrix of ones and event window market returns. $\hat{\Theta}_i$ is the vector of parameter estimates $[\hat{\alpha}_i \hat{\beta}_i]'$.

Under the null hypothesis “the abnormal returns for an individual security are equal to zero”, the following simple results are shown to hold in Campbell et al. (1997)

$$E[\hat{\epsilon}_i^*] = 0 \quad (5)$$

and

$$\mathbf{V}_i = \mathbf{I}\sigma_{\epsilon_i}^2 + \mathbf{X}_i^* (\mathbf{X}_i^* \mathbf{X}_i^*)^{-1} \mathbf{X}_i^{*'} \sigma_{\epsilon_i}^2, \quad (6)$$

where \mathbf{I} is an $L_2 \times L_2$ identity matrix.

We aggregate individual daily abnormal returns by averaging them over securities and thus obtain daily average abnormal returns

$$\bar{\epsilon}^* = \frac{1}{N} \sum_{i=1}^N \hat{\epsilon}_i^*, \quad (7)$$

and correspondingly the variance is

$$\text{Var}[\bar{\epsilon}^*] = \mathbf{V} = \frac{1}{N^2} \sum_{i=1}^N \mathbf{V}_i. \quad (8)$$

Since $\sigma_{\epsilon_i}^2$ in (6) is not known we use instead its consistent estimate

$$\hat{\sigma}_{\epsilon_i}^2 = \frac{1}{L_1 - 2} \hat{\epsilon}_i^* \hat{\epsilon}_i^*. \quad (9)$$

Finally we also aggregate the average abnormal returns over the days of the event window to obtain *cumulative average abnormal returns* ($\overline{\text{CAR}}$) for the event. With ι a unit $(L_2 \times 1)$ vector we have

$$\overline{\text{CAR}}(\tau_1, \tau_2) \equiv \iota' \bar{\epsilon}^* \quad (10)$$

and

$$\text{Var}[\overline{\text{CAR}}(\tau_1, \tau_2)] = \bar{\sigma}^2(\tau_1, \tau_2) = \iota' \mathbf{V} \iota. \quad (11)$$

Again, $\bar{\sigma}^2(\tau_1, \tau_2)$ is unknown and we use its consistent estimate

$$\hat{\sigma}^2(\tau_1, \tau_2) = \frac{1}{N^2} \sum_{i=1}^N \ell' \mathbf{V}_i \ell. \quad (12)$$

We use

$$J_1 = \frac{\overline{\text{CAR}}}{\hat{\sigma}^2(\tau_1, \tau_2)} \stackrel{a}{\sim} \mathcal{N}(0, 1), \quad (13)$$

to test the null hypothesis.²⁵

As an alternative specification, to verify the robustness of our results, we use the *mean model*, where the mean return of the individual security is used as the counterfactual return. In this case the model is simply $R_{i\tau} = \alpha_i + \epsilon_{i\tau}$. This does not introduce changes in the computation of the test statistics, except that we have to adjust the matrices X and X^* so that now they are vectors of ones of dimensions L_1 and L_2 , respectively. In principle, it is possible that a change in the share price of a very large firm may cause a change in the relevant stock market index, giving rise to endogeneity problems. Using the mean model rather than the market model avoids this problem. In Section 3.2 we estimate the mean model to deal with this issue.

3 Results

In this Section, we first describe our main results, then we report the various robustness checks we have carried out, and finally we discuss the issue of cross-sectional correlation and argue that it is not a problem in our case.

Summary statistics for average abnormal returns in the estimation and event periods for all events are reported in Table 1.

We report abnormal returns for the three events for an event window period of eleven days, together with their J -statistics in Table 2.²⁶

INSERT TABLES 1 AND 2 HERE

Abnormal return on the day of the raid is negative and highly statistically significant, suggesting a 0.9% drop in the firm's share price the very same day the dawn raid is carried out. This implies a very quick relay of the news to investors. A large number of studies indicate that stock markets react very quickly to unexpected news.²⁷ Similarly, a negative return of about

²⁵The distributional result is for large samples and is not exact because an estimator of the variance appears in the denominator.

²⁶In our sample the share prices data for three of the firms were no longer available in our database at the time of the decision of the Courts, even though these were available at the time of the Commission Decision.

²⁷Brooks et al. (2003) investigate a sample of 21 fully unexpected negative news events - such as the Exxon-Valdez oil disaster, plant explosions, plane crashes, deaths of executives - and find that share prices fall by an average of 1.6% after a mere 15 minutes. They stress that they find longer response times (!) than reported by previous studies.

0.5% one day after the raid is significant at the level of 5%. If we aggregate the abnormal returns over the window of Table 2, we find significant negative returns for the dawn raid, with an overall effect of the raid amounting to a 2.3% drop in the firm’s stock market valuation.

In the column for the Commission Decision we have a negative abnormal return of about 0.3%, significant at the level of 10% five days before the event and on the day of the event. A cumulative average abnormal return over the 11-day window is at about -1.2% and is statistically significant at the level of 5%.

The last two columns in Table 1 analyse the effects of the Court judgments. We define as “annulments” all judgments which either annul the fine or reduce it by more than 50%, and “upheld” all remaining judgments.

In the column for the Court’s annulment we have statistically significant positive abnormal returns one and three days before the date of the judgment of the Court, which may indicate that a favourable decision was expected by investors, and a positive cumulative average abnormal return over the event window of about 2.3%, which is significant at the level of 10%.

Finally, in the columns for upheld decisions, a negative return 5 days before the decision of the Court was taken is significant at the level of 10%. Cumulatively, the negative average abnormal return is -1.4% and is significant at the level of 10%.

These are the base results. We now discuss them more thoroughly and refine our estimates, dealing with each of the antitrust events in turn.

3.1 Robustness of the results

3.1.1 Results for cartels only

First of all, note that our sample is composed of different types of antitrust infringements. It may be legitimate to wonder to what extent the results are affected by such differences. To dispel doubts, we select the sub-sample of cartel cases (itself a subset of article 81 cases), which accounts for roughly 4/5 of the whole sample, and carry out the same analysis executed above. The results are described in Table 3, which shows that the results are very similar to those obtained for the whole sample. We have not carried out estimates for the sub-sample of non-cartel cases because they involve too few cases.

INSERT TABLE 3 HERE

3.1.2 Dawn Raids

Inspecting back issues of the *Financial Times* we were unable to find any evidence of a surprise inspection not being a genuine surprise. Thus, we

take a shorter window of 5 days (-1..+3 days) for this event to maximise the power of the test.

For this window, the cumulative abnormal return is **-0.0195** with a J value of -3.19 , which gives a statistical significance at the level of 1%. The significant negative abnormal return is robust to variations in the size of the event window.

As a further robustness check of our results, we inspect abnormal returns for individual firms. Most of the firms have negative abnormal returns, of which 5 are statistically significant in the 5-day event window. One of the firms from the sample had a positive significant abnormal return. Figure 2 depicts standardised abnormal returns for individual firms. The solid line represents a standard normal distribution. On the vertical axis are the indices of firms ordered by the size of the abnormal returns and on the horizontal axis are abnormal returns. From the figure we can see that the normal distribution first order stochastically dominates the distribution of abnormal returns.

INSERT FIGURE 2 HERE

Additionally, we plot abnormal individual cumulative returns for each firm for 5 days before the dawn raid and 5 days after the dawn raid in Figure 3. Next to each of the lines depicting differences are indices of the firms, and on the horizontal axis are cumulative returns to individual securities for the five-day windows before and after the event. The dashed lines represent the securities for which the cumulative abnormal return in the window after the raid was higher than the cumulative abnormal return before the raid and the solid line is for the firms for which the opposite is true. It can be seen that only for 16 out of 50 firms are the lines dashed, i.e. their returns are higher after the raid. Moreover, the largest differences among these firms tend to be smaller than the largest ones among firms whose returns are lower after the raid.

INSERT FIGURES 3 AND 4 HERE

We also inspect the empirical distribution of the cumulative abnormal returns for our estimation window. For this purpose we compute abnormal returns using a moving window of the same size as the event window over the periods of the estimation window. We move the first date of the hypothetical event window from $T_0 = -130$ until $T_1 - L_2 = -14$ to obtain $L_1 - L_2 = 117$ hypothetical cumulative average abnormal returns. The distribution of these returns gives us an estimate of the distribution of abnormal returns under the null hypothesis. This distribution is depicted by a solid line in Figure 4. The dashed lines represent the normal distribution.

The empirical distribution of cumulative average abnormal returns is not too far from normal. In the figure the 0.025th and 0.975th quantiles of the

distribution are represented by solid vertical lines. It can be seen that the cumulative average abnormal return from the event window (-0.019) falls well outside the acceptance region if we accepted the empirical distribution as the true one under the null hypothesis. We view these results as an additional confirmation of the robustness of significance of the J value and the significance of the negative effect of the surprise inspection on the value of the firm.

Given that there are good reasons to believe that the surprise inspection is really unexpected, and under the assumption of EMH, we can interpret the abnormal return in the window as the overall loss in the firm's value (due to expected fines, termination of profitable activities and so on) brought about by the Commission's investigation.

One of the possible sources of information to investors that the Commission would start an investigation is when an investigation on the same infringement is already under way in the US. We have therefore excluded the observations for which we know that an antitrust procedure had already started in the US and this information was publicly accessible at the time of the raid by the Commission. The results we obtain with this restricted sample with 40 observations are similar to those obtained using the whole sample. For the 11-day window we have for surprise inspections a cumulative abnormal return of about -1.6% with the J-statistic of -1.73 , which indicates statistical significance at the level of 5% .^{28,29}

3.1.3 Commission Decisions

It is somewhat surprising that the Commission Decision results in a significant cumulative abnormal return in the 11-day window, as we would expect the market to incorporate expectations about it in the share price. To verify the robustness of these results we plot the analogue of Figure 4 also for the Decision of the Commission over the 11-day window. The empirical distribution (solid curve) and the normal distribution (dashed) with the same variance and mean are depicted in Figure 5. The area outside the two solid

²⁸US cases that we exclude in this way are: (Lysine) Archer Daniels Midland, Ajinomoto, Kyowa Hakko Kogyo, Daesang; (Citric acid) Archer Daniels Midland, Bayer; (Graphite electrodes) SGL, Showa Denko K.K., Tokai Carbon, Nippon Carbon, SEC, The Carbide Graphite Group; (Vitamins) BASF, Aventis, Takeda, Merck, Daiichi, Lonza, Solvay, Eisai, Sumitomo, Tanabe Seiyaku, Roche; (Auction houses) Christie, Sotheby; (Sorbates) Hoechst; (Specialty graphite) Carbone Lorraine, SGL. Note, however, that for only 11 of these excluded firms do we have a date of the dawn raid and data on share prices available, so that the restricted sample has 40 observations.

²⁹In a further check, we exclude those firms which have applied for leniency. This is because one may think that if a firm has applied for leniency and revealed information about a cartel, there may be some rumour in the market that an investigation may start soon. Again, the results for the dawn raid are very similar: for the 11-day window we get a cumulative abnormal return of -2.4% with a J-statistic of -2.54 , thus significant at the level of 1% .

vertical lines denotes a rejection region at the level of significance of 10%. The cumulative abnormal return of approximately -1.2% does not fall into the rejection region. This is an indication that the results for the Commission Decision are somewhat less clearcut and less robust for the 11-day window than the results for the surprise inspection are.

INSERT FIGURE 5 HERE

Since we believe that there may be some informational leakages occurring prior to the date of the Decision, we extend the estimation window to the periods from 25 days before the event until 3 days after the event to try to account for this possibility. *Cumulative average (across firms) abnormal return for this event window is -0.033 and is significant at 5% with a J value of -2.63.*

Similarly, as for the 11-day window we also depict the empirical distribution of cumulative average returns for the 29-day moving window in Figure 6. This figure is the equivalent of Figure 4, discussed above for the case of raids. The empirical distribution of cumulative average abnormal returns for this case is quite far from normal, as can be seen by comparing the solid and the dashed curves. This fact raises some concern about the validity of the significance of our results for the Commission Decision also for the 29-day event window, though the cumulative abnormal return in this case falls well into the rejection region at a 5% two-sided test significance.

INSERT FIGURES 6 AND 7 HERE

Figure 7 depicts standardised abnormal returns for individual firms. The solid line represents a standard normal distribution. On the vertical axis are the indices of firms ordered by the size of the abnormal returns and on the horizontal axis are abnormal returns. From the figure we can see that the normal distribution first order stochastically dominates the distribution of abnormal returns. However, it is again clear that the result for the Commission Decision is not as strong as the one for the surprise inspection.

Overall, and albeit less robust and less statistically significant than for the dawn raid, it seems that the Commission Decision does have a negative effect on a firm's valuation. This result begs certain questions, since the Decision comes after other events (such as the raid and the Statement of Objections) which represent strong signals of the seriousness of the investigation.

It is not impossible that this result is caused by sample selection. Our sample includes only the cases where a negative Decision was reached (we do not have data for positive Decisions, since as explained above the Commission does not issue a Decision if it decides not to pursue the case further). Thus, we only have a sub-sample of all the investigations. Those (rare) cases

in which a favourable Decision has been reached are not included and this way the investors may be systematically negatively surprised by the negative Decision for our sample. It is widely believed that the Commission seldom drops a case after a dawn raid and a Statement of Objections, but it is difficult to objectively assess the extent to which this sample selection bias may be important.

3.1.4 Expectations of investors about the Court judgment

It is conceivable that investors are able to predict to some extent whether the Decision of the Commission will be annulled by the Courts at the time of the raid or at the time of the Commission's Decision. In that case, we would expect the negative effect to be absent or at least weaker than in the case where the market expects the Decision to be upheld. For this purpose we re-estimate the effects for the raid and the Decision of the Commission for two separate sub-samples, i.e. the cases in which the Court ultimately annulled (or substantially reduced) the fine, and those in which the Court upheld (or only slightly reduced) them. The results are reported in Table 4.

INSERT TABLE 4 HERE

For both the dawn raid and the Commission Decision we find an insignificant result for the sub-sample of cases for which the Decision of the Commission was later annulled by the Courts.

However, for the subsample of cases for which the Decision was later upheld we find a large negative and significant cumulative abnormal return at the time of the dawn raid. At the same time, the return for the Commission's Decision is negative and significant at the level of 10%. This, in comparison with the results for the Decisions which were later annulled, may be an indication that indeed the investors anticipate partially the infringements for which the Commission has a firm case likely to be upheld by the court.

3.1.5 Court judgments

As seen in Table 2 above for the sample of 29 observations for firms whose fine has been annulled by the Courts, we find a positive and significant average abnormal return one and three days before the Court judgment, and a cumulative average abnormal return of +2.3% which is significant at the level of 10%.

On the other hand, for the sub-sample of cases for which the Court has upheld the Decision of the Commission, the cumulative average abnormal return is negative, and significant at the 10% level.

In general, therefore, the Court's antitrust judgments do seem to have a significant effect on the firm's stock market value, at least in the cases of favourable judgment for the firm.

The positive market reaction (2.3%) allows the firms to recover almost half of the market value lost because of the dawn raid and the Commission decision (which amount to -5.3%).³⁰

This means that the net effect of the antitrust investigation and of an infringement Decision is negative even after a Court judgment which annuls the fine. This can be explained by the fact that - as pointed out in the Introduction and confirmed in the discussion in Section 4 - the fine itself is only part of the loss that a firm may incur because of the investigation. Suppose, for instance, that the judgment annuls the Commission decision for procedural reasons; the firm has won the case, but still it is unlikely that it could continue a business practice which is regarded as anticompetitive by the European Commission, and ceasing a profitable activity will entail a loss in market value. But even when the judgment is favourable to the firm on the substance, the firm may still have incurred costs which it will not be able to recover, such as legal costs and the costs entailed by having the management occupied on antitrust rather than commercial matters.

3.2 Possible sources of endogeneity

The fact that the firms in our sample are often big, established companies that enter in the composition of stock market indices, which, in turn, appear as independent variables in the model of counterfactual returns, may be a source of endogeneity bias in the estimates. As a further check of robustness of our estimates, we ran regressions using the mean-model of the counterfactual, described at the end of Section 2 above. The results go in the same direction, but the significance levels are - not surprisingly - lower than for the market model. The average abnormal return for a surprise inspection and its J -value are -0.019 and -1.74 , respectively. For the Decision of the Commission, however, the average abnormal return cumulated over the same period as for the market model estimates and the corresponding J -value are -0.01 and -1.25 , and are thus not significant.

3.3 Possible sources of bias

In the presence of cross-sectional correlation the inference on the base of the derived J statistic may be biased upwards. The bias is a function of the number of the observations in the sample and the average correlation coefficient. In an influential paper, Bernard (1987) gives some empirical evidence on the seriousness of the problems of inference in the presence of

³⁰We take here the values for the 5-day window for the raid and for the 29-day window for the Commission Decision.

cross-sectional correlation. He argues that the problem can become serious at the values of mean correlation coefficient of a magnitude of around 0.2 for a sample of the size of ours.

Because the firms in a cartel typically operate in the same industry, and as they are often raided on the same day (see Table A.1 in the Appendix), we have some clustering of abnormal returns across firms. However, the extent of clustering for our sample is not likely to cause a serious inference problem, according to Bernard's results: in our case, the mean correlation is 0.005, and is thus not likely to present a serious source of bias in our estimations of the standard error. Moreover, the distribution of covariances, summarised in Table 5 for all pairs of firms demonstrates that a relatively small fraction of all pairs of surprise inspections exceeds the reference 0.2 correlation coefficient for the mean correlation.

INSERT TABLE 5 HERE

One of the possible sources of bias in our estimates may also be the changes in the legal regime (for example, changes in the harshness of the fining policy), which could introduce one or more structural changes in the data-generating process. To explore this issue we have plotted the estimated abnormal returns at the dates of the dawn raids chronologically ordered, with time on the horizontal axis. It is clear from that figure that it is hard to identify a structural break or a clear pattern of evolution of abnormal returns in time.

INSERT FIGURE 8 HERE

4 Conclusions

We have estimated, by using event study techniques, the impact of various events in an antitrust investigation on a firm's stock market value. Our main result is that the dawn raid (i.e., the surprise inspection of the firm's premises carried out by the Commission), which is the first piece of information received by market operators indicating that the European Commission intends to investigate an antitrust infringement, has a strong and statistically significant effect on the firm's share price: on average, on the same day as the dawn raid the firm's return is around 1% lower than the counterfactual return provided by the market model; furthermore, the cumulative average abnormal return due to the dawn raid is approximately -2%.

Somewhat surprisingly, since one might expect that after the dawn raid the market would be able to anticipate that the antitrust investigation will lead to serious consequences for the firm, we find that the Commission's infringement Decision also has some effect on the firm's valuation. Although the evidence is less clearcut and robust than the one obtained for the dawn

raid (although this is also due to the fact that the Commission Decision, unlike the dawn raid, is preceded by rumors), we find that a negative Decision results in a (statistically significant) cumulative abnormal return of about -3.3%.

Our final result is that the judgment by the Court annulling (or considerably reducing) the fine has a positive impact on the firm's market valuation (the cumulative average abnormal return is about +2.3%), whereas a judgment which upholds the fine results in a small decrease (about -1.4%) in the firm's valuation.

Deterrence is determined by the probability that an infringement will be uncovered and prosecuted by the Commission multiplied by the costs that the firm incurs if the investigation does take place. The former factor is difficult to estimate, and our paper is silent on this. But our analysis tells us something about the latter, which could be obtained as an estimated loss of 5.3% of the firm's stock market value, calculated by adding the loss in stock market value due to the dawn raid (2%) and the loss due to the formal Decision (3.3%).

However, one should not conclude that antitrust penalties amount to a loss of 5.3% of stock market value. Indeed, the fine represents only part of this capitalisation loss, the remaining part resulting predominantly from the (likely) cessation of a lucrative activity - which cannot be considered a penalty for an infringement. In the US, Bosch and Eckard (1991) estimated that fines and damages account for 13% of the total loss in the firm's stock market value. In our case, the fine represents on average around 1% of the firms' market value as reported by Datastream.³¹ Since the estimated total negative effect on the share price is about 5.3%, the fine accounts for about 19% of the total loss.³²

The higher weight of the fines in the total loss in the firm's value we obtain for our EU data is consistent with the existence of treble damages in the US (but not in the EU), which add to the negative effects of the fines and the likely cessation of lucrative activities.

To determine whether the magnitude of a negative market reaction at the time of the surprise inspection depends on the relative magnitude of the fine later imposed on the firm by the Commission, we regress the abnormal returns on a constant and the ratio of the fine over the total capitalisation of the firm. We find that the coefficient on the relative size of the fine is

³¹We were unable to retrieve data for capitalisation at the date of the raid; instead we have the outstanding value of shares that we use in computation of abnormal returns for the given firm and capitalisation in September 2006. To approximate capitalisation at the time of the raid we multiply the outstanding shares value at the time of the raid with the ratio of capitalisation in 2006 and outstanding value of the same share edition in 2006.

³²If one took the most conservative estimate of the effects of the investigation, and thus did not consider the drop due to the Commission's Decision, one would conclude that fines would account for 50% of the total drop in share prices.

a small negative number, and it is not significant even at the level of 10%. This may be seen as a further indication that the fines are not the main component of the cost of an antitrust investigation.

In recent years, there has been a wide debate in the EU on how to increase deterrence of anticompetitive practices, in particular cartels.³³ The fact that several firms are repeat antitrust offenders, and the fact that the breach of competition laws rarely triggers top management changes in firms, may be suggestive of a scarce deterrence effect of antitrust penalties.

So far, though, there has been no attempt to study the extent to which EU investigations and penalties have significant effects on the firms infringing competition laws. This paper's objective was precisely to help quantify these effects.

It is difficult to say whether the estimated effects of the antitrust investigations on the firms' share prices should be considered large or small. To help make comparisons, it may be useful to compare our results with those works estimating the effects of events with characteristics similar to those of antitrust events. Gunthorpe (1997) uses event study techniques to investigate the effect of the first announcement in the Wall Street Journal that a firm is involved in some form of illegal behaviour, such as racketeering, patent infringements, or fraud (for instance, false advertising and securities fraud). She finds that on the very same day of the announcement, the average abnormal return is -1.325%, and that the cumulative average abnormal return on an 11-day event window (like the one we use in Table 2) is -2.3%. The magnitude of these effects (which on average probably concern legal infringements of less gravity than antitrust ones) is similar to that of the dawn raids, which are also unexpected events.

Since Commission Decisions, and to a minor extent the Court judgments, are not entirely unexpected events, we need to find events sharing these features for the sake of making comparisons. MacKinlay (1997) analyses the effects on share prices of announcements that actual earnings are more than 2.5% less than expected. On the same day as this announcement is publicly made, the firm's share drops by -.68%, while the cumulative average abnormal return on the 41-day event window (comparable to the length of the long event window we used for the Decision) is of about -1.26%. The estimated effects of such relatively minor 'bad news' are therefore of an order of magnitude not so different from the estimated effects of the news that the European Commission has decided to fine a firm for an antitrust infringement.

³³Several countries have increased fines for antitrust infringements, and some (for instance the UK) have introduced criminal penalties. The European Commission has launched an initiative to facilitate the use of private actions for damages and has just revised its Guidelines for imposing fines with the objective of increasing their deterrent effect (see footnote 6 above).

Still, in our case the overall impact of the antitrust investigation is determined by the sum of the effects of the dawn raid and of the Decision, so the above comparisons taken individually just give some idea of the magnitude of the effects. Admittedly, therefore, it is very difficult to say anything on whether the estimated effects are “large” or not, and above all on whether they are sufficient to provide deterrence against anticompetitive actions. Hopefully, this paper will promote discussion and more empirical works on this issue.

We also believe that our paper offers some evidence on the effectiveness of antitrust intervention. Since most of the drop in the share prices we observe is not caused by the fines, it must be due to the likely cessation of profitable cartel activity (or other unlawful business practices). In turn, this should imply that investors expect investigated and fined firms not to be able to sustain high prices any longer. Therefore, although we cannot offer direct evidence on this issue, our paper indirectly suggests that antitrust intervention does have an effect on product market prices.

FIGURES AND TABLES

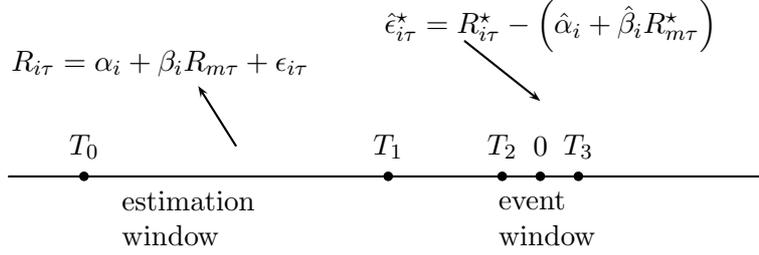


Figure 1: Timeline

Table 1: Summary of average abnormal returns for individual firms in the estimation and event windows

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Raid $T_2 = -1$ $T_3 = 3$						
Estimation	-5.649e-19	-1.019e-19	-2.912e-21	-4.260e-22	1.567e-19	4.122e-19
Event	-0.0374100	-0.0087740	-0.0049030	-0.0052110	-0.0003391	0.0177700
Commission Decision $T_2 = -25$ $T_3 = 3$						
Estimation	-1.097e-18	-1.206e-19	-1.702e-20	-9.612e-21	1.051e-19	8.468e-19
Event	-0.0194400	-0.0025400	-0.0005637	-0.0010230	0.0012010	0.0075010
Court Decision $T_2 = -5$ $T_3 = 3$						
Estimation	-8.624e-19	-1.481e-19	-4.839e-20	-5.369e-20	6.022e-20	9.212e-19
Event	-0.009308	-0.002263	0.002039	0.003286	0.005605	0.039320

Table 2: Summary of results

Panel 1.

Event:	Dawn raid		Comm. Dec.		Annulled		Upheld	
	50 obs.		125 obs.		29 obs.		40 obs.	
time	Abn. ret.	J	Abn. ret.	J	Abn. ret.	J	Abn. ret.	J
-5	-0.00001	-0.00487	-0.00317	-1.55281*	-0.00259	-0.64977	-0.00401	-1.37580*
-4	0.00363	1.35213*	-0.00077	-0.37768	0.00239	0.59713	-0.00058	-0.20012
-3	-0.00321	-1.19593	-0.00125	-0.61228	0.01015	2.52944***	0.00286	0.98273
-2	-0.00271	-1.01036	-0.00077	-0.37507	0.00163	0.40853	0.00280	0.96093
-1	0.00067	0.24833	-0.00025	-0.12282	0.00880	2.18987***	-0.00318	-1.09210
0	-0.00918	-3.42281***	-0.00301	-1.47089*	0.00210	0.52672	-0.00362	-1.24138
1	-0.00507	-1.88995**	-0.00223	-1.09285	0.00393	0.98492	-0.00018	-0.06034
2	-0.00394	-1.46855*	-0.00029	-0.14018	0.00050	0.12535	-0.00057	-0.19646
3	-0.00405	-1.51062*	0.00262	1.27945	-0.00141	-0.35115	-0.00289	-0.99156
4	0.00135	0.50364	-0.00130	-0.63177	0.00075	0.18785	-0.00347	-1.19320
5	-0.00071	-0.26401	-0.00137	-0.67342	-0.00351	-0.88177	-0.00073	-0.24966

Panel 2.

	CAR	J	CAR	J	CAR	J	CAR	J
cum.	-0.02325	-2.49450***	-0.01178	-1.65940**	0.02275	1.63300*	-0.01357	-1.33810*

* significant at 10%, ** significant at 5%, *** significant at 1%

Table 3: Summary of results for article 81 cases only

Panel 1.

Event:	Dawn raid		Comm. Dec.		Annulled		Upheld	
	43 obs.		100 obs.		27 obs.		28 obs.	
time	Abn. ret.	J	Abn. ret.	J	Abn. ret.	J	Abn. ret.	J
-5	-0.00049	-0.16184	-0.00362	-1.49878*	-0.00361	-0.85540	-0.00527	-1.42780*
-4	0.00395	1.30569*	-0.00174	-0.71816	0.00373	0.87716	0.00100	0.27217
-3	-0.00372	-1.23128	-0.00110	-0.45739	0.01203	2.82779***	0.00193	0.52300
-2	-0.00299	-0.98965	0.00001	0.00559	0.00222	0.52488	0.00311	0.84121
-1	0.00291	0.96477	-0.00026	-0.10638	0.00874	2.05229***	-0.00480	-1.30148*
0	-0.01133	-3.74904***	-0.00374	-1.53905*	0.00134	0.31766	-0.00157	-0.42480
1	-0.00628	-2.07657***	-0.00300	-1.24364	0.00350	0.82719	0.00012	0.03317
2	-0.00223	-0.73782	-0.00074	-0.30518	0.00028	0.06627	-0.00192	-0.52174
3	-0.00445	-1.47345*	0.00353	1.45394*	-0.00248	-0.58390	-0.00251	-0.68155
4	0.00070	0.23085	-0.00174	-0.71617	0.00111	0.26374	-0.00670	-1.81865**
5	0.00007	0.02441	-0.00241	-1.00053	-0.00293	-0.69397	0.00026	0.07061

Panel 2.

	CAR	J	CAR	J	CAR	J	CAR	J
cum.	-0.02386	-2.27320***	-0.01482	-1.76180**	0.02393	1.62190*	-0.01634	-1.27150

* significant at 10%, ** significant at 5%, *** significant at 1%

Table 4: Summary of results for the cases that were later annulled and upheld

Panel 1.		Annulled				Upheld			
Event:	Dawn raid		Comm. Dec.		Dawn raid		Comm. Dec.		
	8 obs.		31 obs.		20 obs.		41 obs.		
time	Abn. ret.	J	Abn. ret.	J	Abn. ret.	J	Abn. ret.	J	
-5	0.01361	2.44824***	0.00017	0.03848	-0.00098	-0.23140	-0.00811	-1.89620**	
-4	0.00764	1.37482*	-0.01067	-2.40784***	0.00477	1.12535	0.00116	0.26936	
-3	-0.00274	-0.49402	0.00249	0.56394	-0.00555	-1.30522*	-0.00744	-1.74248**	
-2	0.00029	0.05309	-0.00176	-0.39784	-0.00012	-0.02740	-0.00015	-0.03591	
-1	-0.00419	-0.75673	0.00243	0.54968	-0.00306	-0.72402	-0.00072	-0.16785	
0	-0.00676	-1.22055	0.00077	0.17313	-0.01035	-2.44563***	-0.00740	-1.71884**	
1	-0.00028	-0.05029	-0.00628	-1.41707*	-0.00482	-1.13751	-0.00177	-0.41450	
2	0.00515	0.93024	-0.00078	-0.17613	-0.00656	-1.54843*	0.00153	0.35886	
3	-0.00775	-1.39865*	0.00597	1.34207*	-0.00527	-1.24546	0.00243	0.56628	
4	0.00076	0.13812	-0.00925	-2.05925***	-0.00474	-1.12040	0.00261	0.60737	
5	-0.01222	-2.19710***	-0.00179	-0.40537	0.00168	0.39553	-0.00223	-0.52168	

Panel 2.		Annulled		Upheld		Annulled		Upheld	
	CAR	J	CAR	J	CAR	J	CAR	J	
cum.	-0.00648	-0.33711	-0.01870	-1.20930	-0.03501	-2.37770***	-0.02008	-1.34940*	

* significant at 10%, ** significant at 5%, *** significant at 1%

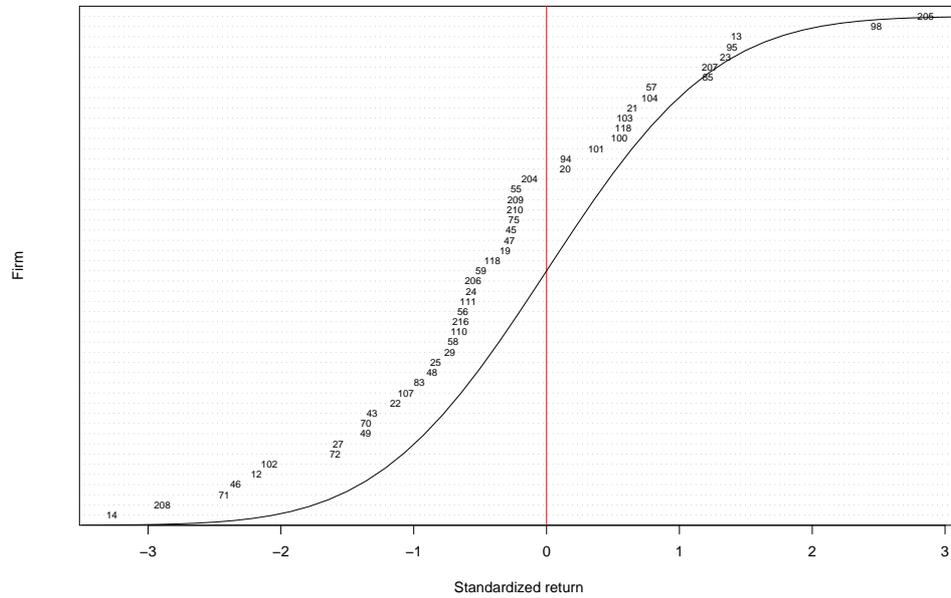


Figure 2: Cumulative abnormal returns for individual firms for Surprise Inspection ($T_2 = -1$ $T_3 = 4$)

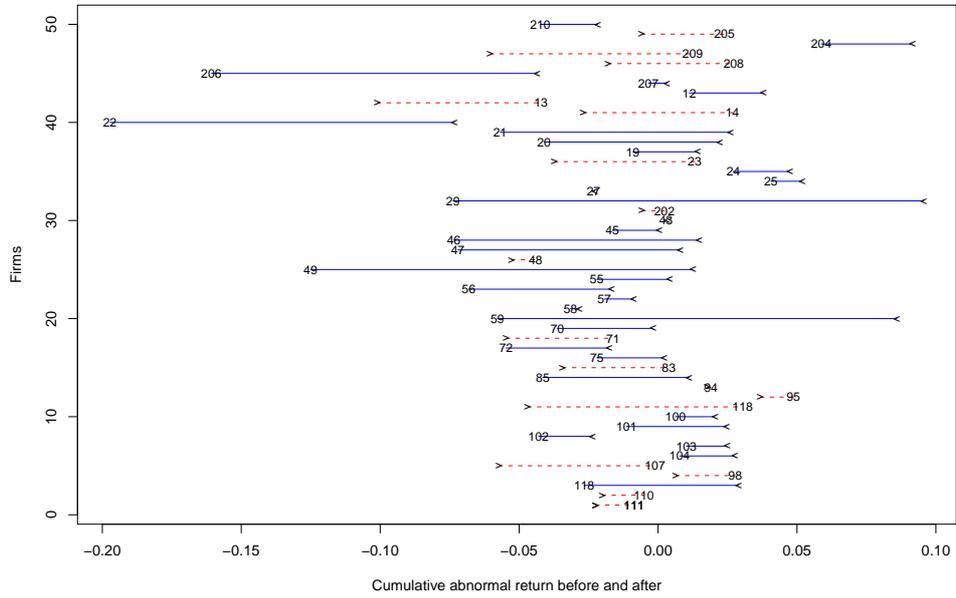


Figure 3: Before and after the event cumulative average abnormal returns for Surprise Inspection (before: -5.-1; after: 0.4)

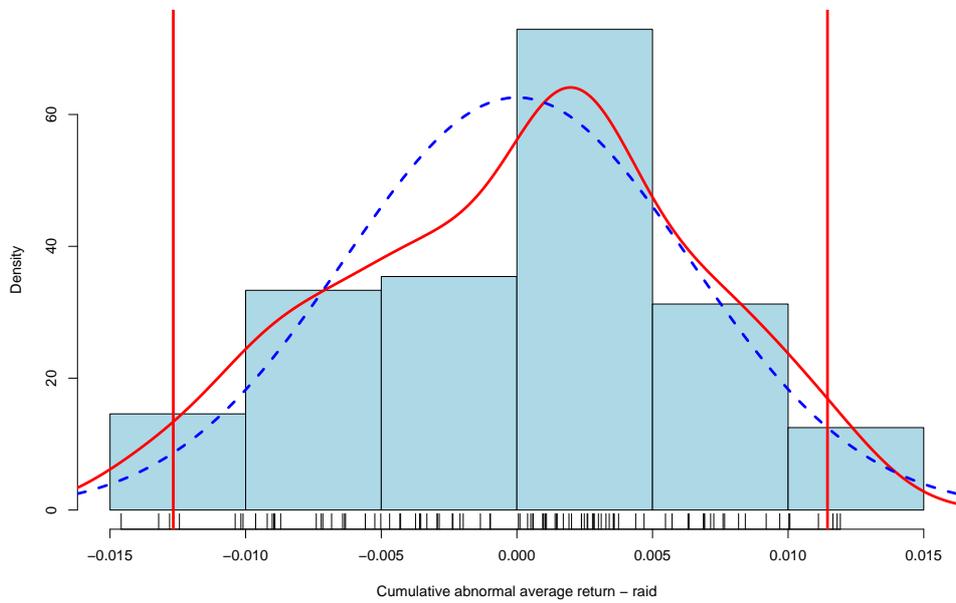


Figure 4: Empirical distribution of cumulative average abnormal returns for Surprise Inspection (sum over 5 periods).

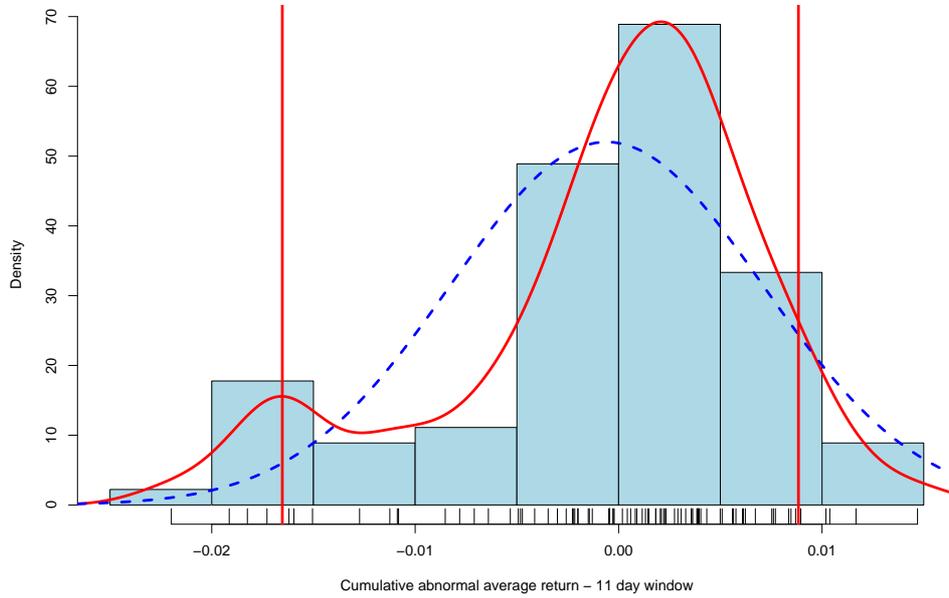


Figure 5: Empirical distribution of abnormal cumulative average returns for Commission Decision (sum over 11 periods).

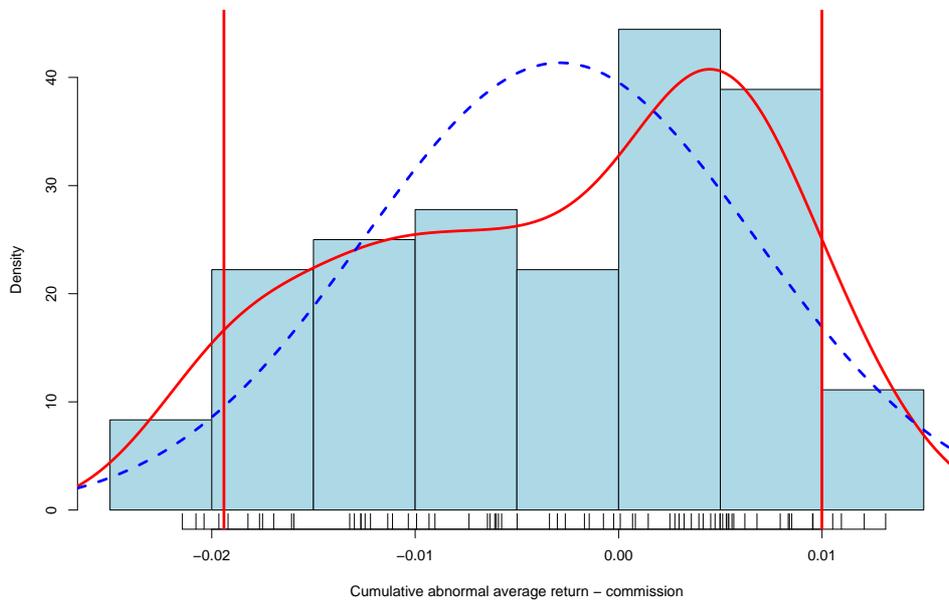


Figure 6: Empirical distribution of abnormal cumulative average returns for Commission Decision (sum over 29 periods).

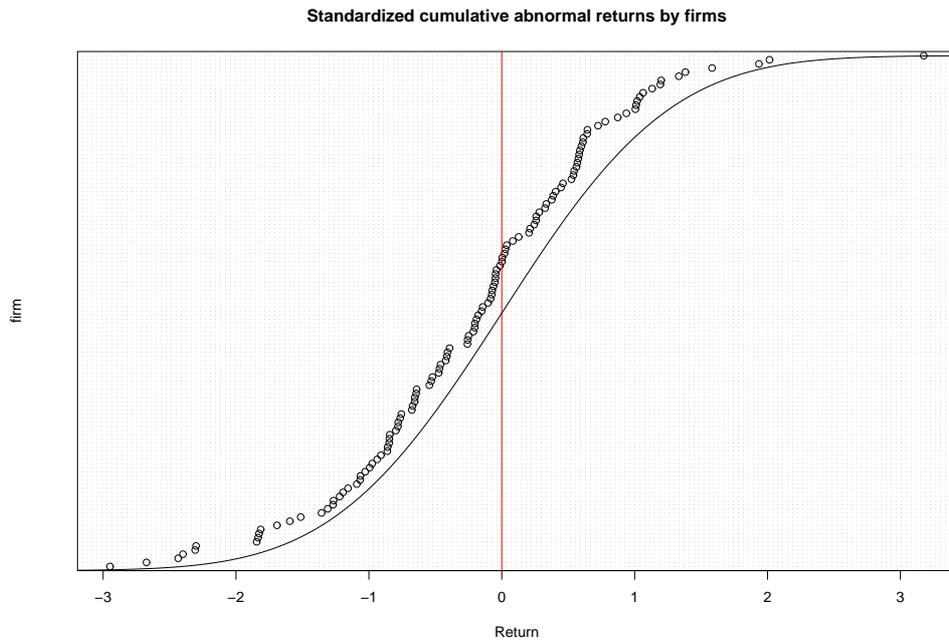


Figure 7: Distribution of cumulative abnormal returns for individual firms for Commission Decision ($T_2 = -25$ $T_3 = 3$)

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
-0.25	-0.12	-0.08	-0.05	-0.02	0.003	0.03	0.05	0.08	0.11	0.49

Table 5: Distribution of covariances between abnormal returns of firms

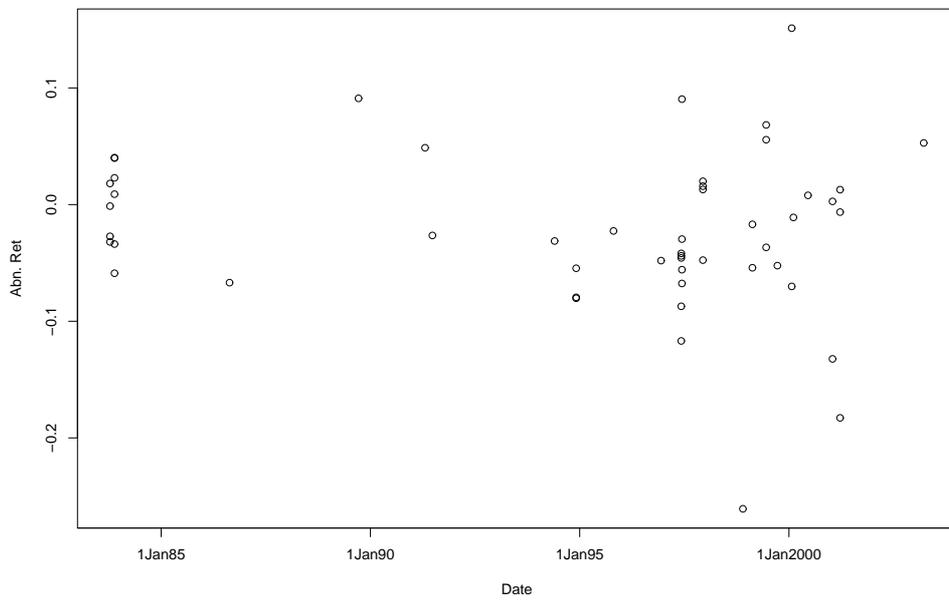


Figure 8: Abnormal returns by dates of dawn raids

APPENDIX

Legend for table: Decision: decision date of the Commission; Surp. insp: the date of the surprise inspection; Dec.Court: date of the decision of the Court; fine/capit.: the ratio between fine as set by the commission and capitalization approximation; Fine Comm: fine of the commission in million Euro; Fine Court: fine as set by the Court.

Table A.1: List of observations

Art	Decision	Surp. insp.	Dec. Court	index	Firm	Fine Comm.	fine/capit.	Fine Court
82	14/12/1979		7/06/1983	117	Pioneer	0.3		0.2
81	25/11/1980			116	Johnson & Johnson	0.2		
82	17/12/1981		8/11/1983	115	Siemens	0.04		0.04
82	14/12/1985		3/07/1991	114	AKZO	10		7.5
82	18/12/1985			113	Fanuc	1		
82	18/12/1985			112	Siemens	1		
81	23/04/1986	13/10/1983		111	BASF	2.5	0.0010	
81	23/04/1986	13/10/1983	24/10/1991	110	Hoechst	9		9
81	23/04/1986	13/10/1983		118	Shell	9.000	0.0004	
81	23/04/1986	13/10/1983		98	Solvay	2.500	0.0047	
82	10/07/1987		8/02/1990	109	Beiersdorf	0.01		0.01
82	18/12/1987			108	Konica	0.08		
82	5/12/1988	21/08/1986	1/04/1993	107	BPB	0.15		0.15
81	21/12/1988		27/02/1992	106	Norsk Hydro	0.75		0.75
81	21/12/1988		27/02/1992	105	Solvay et Cie	3.5		3.5
81	21/12/1988	21/11/1983	27/02/1992	104	BASF	5.5	0.0020	0
81	21/12/1988	21/11/1983	27/02/1992	103	Bayer	2.5	0.0007	0
81	21/12/1988	21/11/1983	27/02/1992	102	Dow Chemical	2.25	0.0002	0
81	21/12/1988	21/11/1983	27/02/1992	101	Hoechst	1		0
81	21/12/1988	21/11/1983	27/02/1992	100	Imperial Chemical Industries	3.5	0.0009	0
81	21/12/1988	21/11/1983	27/02/1992	118	Shell	0.85	0.0000	0
82	13/12/1989		29/05/1991	99	Bayer	0.5	0.0001	0.5
81	19/12/1990		29/06/1995	98	Solvay	7		0
81	19/12/1990		29/06/1995	97	Imperial Chemical Industries	7		0
81/2	1/04/1992			96	Nedlloyd	0.03		
82	15/07/1992	19/09/1989	14/07/1994	95	Herlitz	0.04	0.0001	0.04
81	13/07/1994	23/04/1991	14/05/1998	94	SCA Holding	2.2	0.0000	2.2
81	21/12/1994			90	Kawasaki Kisen Kaisha	0.01		
81	21/12/1994			89	Mitsui OSK Lines	0.01		
81	21/12/1994			88	Neptune Orient Lines	0.01		
81	21/12/1994			87	Nippon Yusen Kabushiki	0.01		
81	21/12/1994			86	Orient Overseas Container	0.01		
82	12/07/1995	26/06/1991	19/05/1999	85	BASF	2.7	0.0004	2.7
82	10/01/1996		26/10/2000	84	Bayer	3		0
82	28/01/1998	23/10/1995	6/07/2000	83	Volkswagen	102	0.0131	102
82	16/09/1998		30/09/2003	82	A.P. Moller-Maersk	27.5		0
81/2	16/09/1998		30/09/2003	81	P & O Nedlloyd	41.26		0
81/2	16/09/1998		30/09/2003	80	Orient Overseas Container	20.63		0
81/2	16/09/1998		30/09/2003	79	Neptune Orient Lines	13.75		0
81/2	16/09/1998		30/09/2003	78	Nippon Yusen Kabushiki Kaisha	20.63		0
81/2	16/09/1998		30/09/2003	77	Hanjin Shipping	20.63		0
81/2	16/09/1998		30/09/2003	76	Hyundai Merchant Marine	18.56		0
81	14/10/1998	27/05/1994	12/07/2001	75	Tate & Lyle	7	0.0054	5.6
81	9/12/1998		11/12/2003	74	Minoan Lines	3.26		3.26
82	14/07/1999		17/12/2003	73	British Airways	6.8		6.8
81	8/12/1999	1/12/1994	8/07/2004	72	Vallourec	8.1	0.0243	8.1
81	8/12/1999	1/12/1994	8/07/2004	71	Sumitomo Metal Industries	13.5	0.0000	10.94
81	8/12/1999	1/12/1994	8/07/2004	70	Nippon Steel	13.5	0.0000	10.94
81	16/05/2000		19/03/2003	69	Kawasaki Kisen Kaisha	0.62		0
81	16/05/2000		19/03/2003	68	A.P. Moller - Maersk Sealand	0.84		0
81	16/05/2000		19/03/2003	67	Malaysia International Shipping	0.13		0
81	16/05/2000		19/03/2003	66	Mitsui OSK Lines	0.62		0
81	16/05/2000		19/03/2003	65	Neptune Orient Lines	0.37		0
81	16/05/2000		19/03/2003	64	Nippon Yusen Kaisha	0.62		0
81	16/05/2000		19/03/2003	63	Orient Overseas Container	0.13		0
81	16/05/2000		19/03/2003	62	P & O Nedlloyd Container	1.24		0
81	16/05/2000		19/03/2003	61	Evergreen Marine Corp.	0.37		0
81	16/05/2000		19/03/2003	60	Hanjin Shipping	0.62		0
81	7/06/2000	11/06/1997	9/07/2003	59	Archer Daniels Midland	47.3	0.0037	43.88
81	7/06/2000	11/06/1997	9/07/2003	58	Ajinomoto	28.3	0.0000	28.3
81	7/06/2000	11/06/1997	9/07/2003	57	Kyowa Hakko Kogyo	13.2	0.0000	13.2
81	7/06/2000	11/06/1997	9/07/2003	56	Daesang Corporation	8.9	0.0000	7.13
82	20/09/2000	11/12/1996	21/10/2003	55	General Motors	43	0.0010	35.48
82	20/03/2001			54	Deutsche Post	24		
81	5/12/2001			53	Archer Daniels Midland	39.69		
81	5/12/2001			215	Bayer	14.22		
81	5/12/2001			201	Hoffman La Roche	63.5		
82	20/06/2001		30/09/2003	51	Michelin	19.76		19.76
82	29/06/2001		3/12/2003	50	Volkswagen	30.96		0

81	18/06/2001	5/06/1997	29/04/2004	49	SGL Carbon	80.2	0.0289	69.11
81	18/06/2001	5/06/1997	29/04/2004	48	Showa Denko K.K.	17.4	0.0000	10.44
81	18/06/2001	5/06/1997	29/04/2004	47	Tokai Carbon	24.5	0.0002	12.28
81	18/06/2001	5/06/1997	29/04/2004	46	Nippon Carbon	12.2	0.0002	6.27
81	18/06/2001	5/06/1997	29/04/2004	45	SEC Corporation	12.2	0.0004	6.14
81	18/06/2001		29/04/2004	44	The Carbide Graphite Group	10.3		6.48
81	18/06/2001	15/06/2000		43	SAS	39.38	0.0078	
82	25/07/2001	5/06/1997		42	Deutsche Post	0		
82	10/10/2001	11/12/1996		41	DaimlerChrysler	71.83		
81	21/11/2001		25/02/2003	40	BASF	296.16		296.16
81	21/11/2001		25/02/2003	39	Aventis	5.04		5.04
81	21/11/2001		25/02/2003	38	Takeda Chemical Industries	37.06		37.06
81	21/11/2001		25/02/2003	37	Merck	9.24		9.24
81	21/11/2001		25/02/2003	36	Daiichi Pharmaceutical	23.4		23.4
81	21/11/2001		25/02/2003	211	Lonza	0		0
81	21/11/2001		25/02/2003	34	Solvay	9.1		9.1
81	21/11/2001		25/02/2003	33	Eisai	13.23		13.23
81	21/11/2001		25/02/2003	32	Sumitomo Chemical	0		0
81	21/11/2001		25/02/2003	31	Tanabe Seiyaku	0		0
81	21/11/2001	28/01/1993		202	Hoffman La Roche	462	0.0152	
81	5/12/2001	26/10/1999		30	Groupe Danone	44.04	0.0025	
81	11/12/2001	16/02/1999	14/10/2004	29	Commerzbank	28	0.0023	0
81	11/12/2001	16/02/1999	14/10/2004	28	Dresdner Bank	28		0
81	11/12/2001	16/02/1999	14/10/2004	27	Bayerische Hypo	28		0
81	11/06/2002		14/10/2004	26	Erste Bank	37.69		0
81	2/07/2002	16/06/1999		25	Aventis	0		
81	2/07/2002	16/06/1999		24	Degussa	118.13	0.0197	
81	2/07/2002	16/06/1999		23	Nippon Soda Company	9	0.0001	
81	24/07/2002	11/12/1997		19	Air Liquide	3.64	0.0004	
81	24/07/2002	11/12/1997		20	Air Products Nederland	2.73	0.0003	
81	24/07/2002	11/12/1997		21	BOC Group	1.17		
81	24/07/2002	11/12/1997		22	Linde group	12.6	0.0028	
82	30/10/2002			18	Nintendo Corporation	149.13		
81	30/10/2002			17	Christie	0		
81	30/10/2002			16	Sotheby	20.4		
81	27/11/2002	25/11/1998		15	Lafarge	249.6	0.0283	
81	27/11/2002	25/11/1998		14	BPB	138.6		
81	27/11/2002	15/01/2001		13	Aventis group	2.85		
81	27/11/2002	15/01/2001		12	Merck	0	0.0000	
82	21/05/2003			11	Deutsche Telekom	12.6		
82	16/07/2003			10	Yamaha group	2.56		
81	1/10/2003			9	Hoechst	99		
81	3/12/2003			8	Carbone Lorraine	43.05		
81	3/12/2003			7	SGL Carbon	23.64		
81	10/12/2003			6	AKZO	0		
81	10/12/2003			5	Degussa	16.73		
81	10/12/2003			203	Totalfina	43.47		
81	16/12/2003	22/03/2003		4	Outokumpu	18.13	0.0124	
81	16/12/2003	22/03/2003		207	KME-group	18.99	0.0894	
82	24/03/2004			2	Microsoft	497.2		
82	26/05/2004			1	Topps	1.59		
81	3/09/2004	22/03/2001		206	KME (Europa Metal)	32.75	0.0764	
81	3/09/2004	22/03/2001		208	Outokumpu	36.14	0.0369	
81	3/09/2004	22/03/2001		209	Halcor	9.16	0.0228	
81	29/09/2004	25/01/2000		204	Danone	1.5	0.0001	
81	29/09/2004	25/01/2000		205	Heineken	1	0.0001	
82	15/06/2005	9/02/2000		210	AstraZeneca	14	0.0003	
81	9/12/2004			212	AKZO	20.99		
81	9/12/2004			213	BASF	34.97		
81	9/12/2004			214	UCB	10.38		
82	5/10/2005	22/09/1999		216	Peugeot	49.5	0.0053	

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