Firm's damages from antitrust abuse of dominant position investigations

Fotis, Panagiotis

General Directorate of Competition of Hellenic Competition Commission, University of Central Greece, Department of Regional and Economic Development

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Firm's Damages from Antitrust & Abuse of Dominant Position Investigations [+]

Panagiotis N. Fotis[*]

Abstract

Competition authorities carry out investigations and impose legal penalties on firms which are caught infringing the competition law. The rationale of this policy is to prevent firms from distorting free competition in a way that is detrimental to economic efficiency and at the same time to deter them from engaging in cartels and other anti-competitive behaviour. In this paper I try to evaluate the impact of major antitrust & abuse of dominant position investigations on firm's financial value. For this purpose I divide the period of each investigation into two sub periods: the '*Investigation period*', which begins from the outset of the anticompetitive case and ends when the competition authority issues the statement of objections to the infringed firms and the '*Deterrence period*', which follows the '*Investigation period*' and ends with the final judgment of the court. I use *aggregate regression based approach* to estimate the Average & Cumulative Average Residuals of the firms which infringe articles 1 & 2 of Greek Competition Law. The empirical results imply that the release of the final decisions of the Hellenic Competition Commission and the Court of Appeal negatively affect the share price of the infringed firms.

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Key words: Antitrust, competition policy, deterrence, anticompetitive practices, fines, time-series models, regression based approach, quantitative event study, marginal residuals.

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[*]Hellenic Competition Commission, General Directorate of Competition, Director/A΄ Directorate of Economic Analysis and University of Central Greece, Department of Regional and Economic Development.
5 P. Ioakim, Peristeri
12132 Athens Greece
Tel: + 30-210-8809237 Fax: + 30-210-8809136 E-mail address: pfotis@epant.gr

1 Introduction

Antitrust policy aims at preventing companies from abusing market power, restraining free trade, and/or forming anticompetitive agreements. Its objective is to foster competition in the interest of consumer welfare. Therefore, effective antitrust laws imposed by competition authorities are fundamental in competition policy as they prevent firms from distorting effective competition.

Regulator can impose legal and regulatory penalties on firms which are caught infringing the competition law so as to dishearten them from engaging in cartels and other anti-competitive behaviour. Optimal antitrust policy demands that the costs that firms incur when found guilty of antitrust infringement are high enough to make the infringement unprofitable. The financial sanction should exceed the expected profits from the anticompetitive activity in order to compensate for ineffective detection. Sanctions also may offer an incentive to cartel participants to deviate from the cartel and provide critical information to competition authorities to benefit from leniency.

In this paper, I carry out an econometric analysis to explore the effect of antitrust & abuse of dominant position investigations on the share prices of firms which have infringed Greek competition law. Especially, I analyse a sample of major Greek antitrust & abuse of dominant position cases during the period from 2000 to 2010 and I try to evaluate the private damages imposed to the infringed firms. For this purpose I define the '*Investigation period*', which begins from the outset of the investigation and ends when the competition authority issues the statement of objections to the infringed firms and the '*Deterrence period*', which follows the '*Investigation period*' and ends with the final judgment of the court.

I use aggregated data analysis (*regression based approach*) so as to explore the *average* effect of antitrust & abuse of dominant position cases on the stock prices of involved firms. The econometric results imply that during the '*Investigation Period*' and the '*Deterrence Period*', the cumulative average residuals of the infringed firms drop by -2,85% and -2,78% respectively. That is, the release of the final decision of the Hellenic Competition Commission (HCC) and the final decision of the Court of Appeal negatively affect the share price of the infringed firms.

The remainder of the paper is organized as follows. Section 2 provides the major steps of an antitrust & abuse of dominant position case during the *Investigation Period and the Deterrence Period*. Section 3 reviews the literature & section 4 presents the sample and the econometric models which I use in the remainder of the paper. Section 5 introduces the empirical results and section 6 concludes.

2 The Institutional Framework

2.1 The Greek Competition Law

The HCC is the only competition authority for the enforcement of Greek Competition Law, whose main provision against antitrust and abuse of dominant position infringements are articles 1 and 2 of Law No. 3959/2011[1] (Greek Competition Law).

Fines may be imposed to firms which have infringed the abovementioned article according to the *guidelines for setting fines imposed under Article 9 of Greek Competition Law* and *the determination of the range of annual sales from products or services that defines the basic amount of fines for infringements of articles 1, 2* of the

[1] Article 1 of Greek Competition Law deals with Cartels, whereas article 2 of the same Law deals with the Abuse of Dominance position.

same Law and articles 81 & 82 of the Treaty establishing the European Community[2]. Especially, article 8 of the May 2006 guidelines states that the base fines may be up to 30% of the company's annual sales in the market to which the antitrust & abuse of dominant position infringement relates. The percentage is cumulatively calculated on the annual sales for each year of the offense.

During the period from 2000 to 2009 the HCC has imposed a total amount of 290.500.000 euros of fines with respect to articles 1, 2 and 25(2)[3] of Greek Competition Law (Table 1). The year 2007 the HCC imposed the highest amount of fines during the period under consideration (almost 105 million Euros).

Table 1: Total amount of fines for infringements of articles 1,2 & 25[+] of Greek Competition Law from 2000 to 2009 ((*in thousands euro*)

	Years									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Amount of Fine per year	4,402	-	3,311	1,129	0,629	19,172	0,015	103,560	55,489	102,790
Total amount of Fines	290,500									

Source: http://www.epant.gr/img/x2/categories/ctg324_1_1275909535.pdf (in Greek)
[+]See footnote 3.

2.2 Major steps of an investigation by GDC of HCC

The General Directorate of Competition (GDC) of HCC starts its investigation either at its own initiative (a publication in the media, a "*non paper*", an unofficial

[2] Articles 101 & 102 of the Treaty on the functioning of the European Union (TFEU). See also the official website of HCC and especially http://www.epant.gr/img/x2/categories/ctg253_3_1193315361-.pdf and http://www.epant.gr/img/x2/categories/ctg299_3_1247826428.pdf respectively (in Greek).

[3] Article 25(2) of the previous Greek Competition Law No. 703/77 (see also article 38(3) of Greek Competition Law, as applicable), stated that *«ιn case of refusal, recalcitrance or delay in providing the requested preceding paragraph of information or inaccurate information or incomplete, subject to in Article 29 of this Act criminal proceedings the Competition Commission: a) where the undertakings or associations, managers and employees, as well as private individuals or private entities, imposes a fine of fifteen thousand (15,000) million to more than 1% of turnover as calculated in accordance with Article 4f in each of them for any offense, b) where public officials or employees of public entities law referred to officially initiate disciplinary proceedings for the above violations constitute a disciplinary offense.»*.

complaint, e.t.c.) or on the basis of an official complaint[4] by a third party. Generally speaking, there is no a public announcement for the outset of an official investigation.

An antitrust and abuse of dominant position investigation contains two crucial sub-periods: the '*Investigation period*', which begins from the outset of the investigation and ends when the competition authority issues its final decision to the infringed firms and the '*Deterrence period*', which follows immediately after the '*Investigation period*' and ends with the final judgment of the court.

The crucial steps of procedure during the '*Investigation period*' are the down raids, the Statement of Objections and the final Decision of HCC. If the GDC has suspicious that there has been an infringement which violates article 1 (and sometimes article 2) of Greek Competition Law, it may carry out a surprise inspection at the premise(s) of the firm(s) under investigation so as to gather critical documentary evidences for the infringement.

After a period of Investigation the GDC may issue the Statement of Objections (SoO) and send it to the firms under investigation. At the same date it publishes a press release with the main points of the statement of objections, subject to the final decision of HCC.

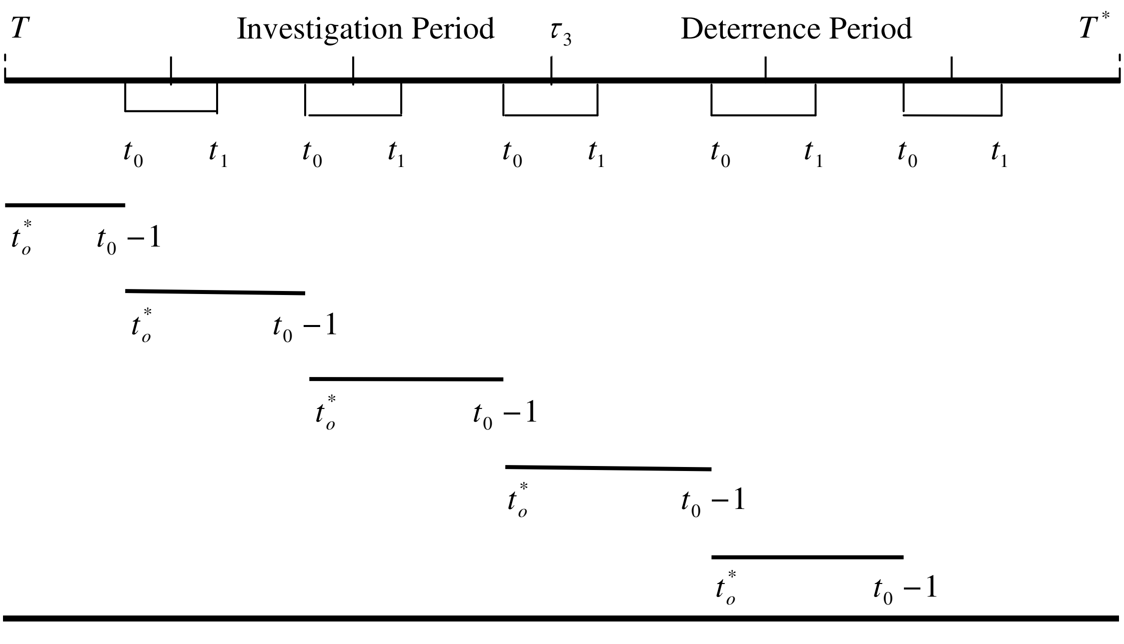
Following the period of the trial procedure, which may last from 1 to 3 months and the submission of statements in terms of involved firms, the HCC issues its Decision, which may or may not accept the Statement of Objections by the GDC. At the date of the final decision the HCC publishes a press release with the main points of its Decision.

[4] See article 36 of Greek Competition Law.

The '*Deterrence period*'[5] begins immediately after the issue of the final decision of the HCC. Firms which have been fined can appeal to the courts (Court of Appeal (CA) and Supreme Court[6]. Court's judgements may annul, reduce, uphold or even increase[7] the fine as well as annul or uphold the overall Decision.

In this paper I assume the following public information which may affect the share price of the infringed firms: a) the down raids, b) the issue of the Statement of Objection, c) the final Decision of the HCC and the Court Decisions. The first three constitute the '*Investigation period*', whereas the last two constitute the '*Deterrence period*' (Figure 1).

Figure 1: Nonoverlapping steps of an antitrust & abuse of dominant position case



Each major step of both periods includes a date of release of the public information. I denote that as $\tau = 0$. In Figure 1 there are five specific dates which correspond to the

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[5] I call the '*Deterrence period*' since after the issuing of the final decision the imposed penalties may dishearten firms from engaging in cartels and other anti-competitive behaviour.
[6] In this paper I investigate only the effect of CA's judgments on infringed stock return.
[7] To the best of my knowledge, Court's judgments have never increase fine imposed by the HCC.

five major steps of case (τ_1 = **down raids**, τ_2 = **Statement of Objections**, τ_3 = **Final Decision of HCC**, τ_4 = **Pre-final Court of Appeal Decision**[8], τ_5 = **Final Court of Appeal Decision)**. Around $\tau's$ there are $t = 1....n$ days which may be affected from the release of the public information. I symbolize the beginning of such a period as t_0 and its end as t_1. Prior to t_0 there are $n-1$ days which are not affected from the abovementioned release. Let's denote t_o^* the beginning of the unaffected period and $t_0 - 1$ its end. The whole period under investigation (T, T^*) includes five sets of $t = 1....n$ days and five sets of $n-1$ days which correspond to different periods of time (**nonoverlapping steps of an antitrust & abuse of dominant position case**). Also, each step of a case includes nonoverlapping stock returns of infringed firms.

3 Review of the Literature

Studies which attempt to measure the effect of an anticompetitive action on involved firm's stock price are, *inter alia*, those of Bosch and Eckard (1991), Detre et al., (2005)[9], Langus & Motta (2009) and Guenster & Van Dijk (2010). All of those studies follow disaggregate regression event approach so as to evaluate the impact of the antitrust actions on the cumulative residual of the infringed firms[10].

Bosch and Eckard (1991) analyze a sample of 127 firms involved in 57 US federal price fixing infringements from 1962 to 1980 and find a statistically significant -

[8] The Court of Appeal temporarily recalls the final decision of the HCC until the issuing of its final decision.

[9] There are also several US studies which investigate various aspects of antitrust policy. See, *inter alia*, Burns (1977), Garbade et al. (1982), Gilligan (1986), Bizjak and Coles (1995), Bittlingmayer and Hazlett (2000) & De Vany and McMillan (2004). Garbade et al. (1982) investigate 34 companies that infringed the Sherman and Clayton Acts from 1934 to 1974, Gilligan (1986) analyse 43 firms convicted for resale price maintenance from 1962 to 1985, Bizjak and Coles (1995) evaluate 481 antitrust cases in the US in the period 1973-1983, Bittlingmayer and Hazlett (2000) analyse the US federal antitrust action against Microsoft in the 1990s and De Vany and McMillan (2004) report the effect of infringed actions by vertically integrated movie studios during the period 1939-1949.

[10] See, *inter alia*, Fotis et al. (2011) for a study which attempts to measure the competitive effects of mergers.

1.08% drop of cumulative residual across the infringed firms around the release of the public information. They point out that the critical part of the estimated residual is expected loss of conspiracy-generated profits, rather than reputation damage. They point out that price fixing infringement is a profitable deal since its profits exceed expected fines, implying that the deterrence effect of antitrust enforcement actions is small.

Detre et al., (2005) examine 24 US price – fixing cases involving 31 firms from 1981 to 2001 and find a 3,41% drop of stock return around the release of the public information. The authors do not further evaluate possible causes of the negative effect of public information on firm's financial value.

Langus & Motta (2009) examine the stock market reaction of 88 firms to 55 European Commission Decisions from 1969 to 2005. They find a statistically residual of -2% around the τ_1 and -3% around the τ_3. They suggest that the negative impact of '*Investigation Period*' on infringed firm's share value results predominantly from lost monopoly profits.

Guenster & Van Dijk (2010) analyse the stock market response to antitrust investigation announcements, infringement decisions and appeals. The sample of involved firms includes 253 firms involved in 118 European antitrust cases over the period 1974-2004. They found significantly negative stock price responses of almost -5% around the dawn raid and 2% around the final decision, and a significantly positive response of up to 4% around a successful appeal, which correspond to a total market value loss of €24 billion around the surprise inspection and the final decision.

This paper differs from the abovementioned articles in the following: firstly, I estimate aggregate regression based approach with which I present the average & cumulative average effect of the release of public information on infringed firm's stock price, secondly, I evaluate a sample of antitrust & abuse of dominant position cases from the HCC during the period from 2000 to 2010 and thirdly, I use adjusted trade to trade stock returns so as to get serially independent residuals.

4 Empirical Methodology and Sample Selection

4.1 Sample Selection

The sample includes 10 completed cases of articles 1 & 2 of Greek Competition Law during the period 2000 – 2010 and 5 cases which are still under investigation. I define a completed case when the Court of Appeal has issued a decision. I also include a case under investigation only in the '*Investigation Period*'.

Especially, the sample of completed cases includes 3 and 7 cases of article 2 and 1 of Law No. 3959/2011 respectively, while the sample of uncompleted cases includes 5 cases of article 1 of the same Law. In the former sample, the Court of Appeal has reduced the fine. The reduction ranges from 19% to 80% of the total amount of imposed fine by the final decision of HCC. In one case the Court of Appeal annul the HCC's final decision[11]. For each case I explicitly determine five $\tau's$ (see Figure 1) and the period around the release of public information from t_0 to t_1. The latter includes 5 trading days prior and after of each τ. I also define the unaffected period t_o^*- $t_0 - 1$ from the release of the public information, which includes 300 trading days prior to t_0.

[11] Due to data limitations I haven't included 5 cases in the sample of '*Deterrence Period*'.

4.2 Empirical methodology

4.2.1 The Calculation of Stock returns

Daily continuously compound stock return for firm j is calculated as follows:

$$R_{j,t} = \ln\left(P_{j,t}\right) - \ln\left(P_{j,t-1}\right) \quad (1)$$

Following Maynes & Ramsey (1993), Bartholdy et al. (2007) and Fotis & Polemis (2010a), I incorporate the *infrequent trading phenomenon* which appears when some stocks do not trade daily in the stock exchange. In such a case, the estimated variance and co-variance of the stock performance will positively correlate with their trade frequency.

Especially, I use adjusted trade to trade return with the time interval of non trading dates. That is, assuming stationarity one day return generating process, the multiperiod return for firm j ending on date t is[12]

$$R_t = \ln\left[\frac{P_{j,t}\hat{P}_{j,t-1}\ldots\ldots\hat{P}_{j,t\ldots\ldots\ldots n_t+1}}{\hat{P}_{j,t-1}\hat{P}_{j,t-2}\ldots\ldots\hat{P}_{j,t\ldots\ldots\ldots n_t}}\right] \quad (2)$$

where n_t is the length of the interval of non trading dates[13] ending at date t and $\hat{P}_{j,t-u}$ is the unobserved stock price of firm j for date $t-u$ ($u = 1\ldots\ldots n_t - 1$). Therefore, the trade to trade return is the sum of n_t unobserved one day returns. By dividing (2) with n_t I derive the *adjusted trade to trade return,* which adjusts the variability in the interval length. Following equation (1) the adjusted trade to trade return is as follows:

$$R_{j,t} = \frac{\ln\left(P_{j,t}\right) - \ln\left(P_{j,t-u}\right)}{n_t} \quad (3)$$

[12] See also equation (3) in Mayens & Ramsey (1993).
[13] The period of trading dates between the trade at period t and the previously successful traded date.

The *trade to trade approach «uses all available information about total stock and market returns over time and no bias is introduced by attempting to estimate unobserved daily stock returns as occurs with the lumped or uniform techniques. However, since trade to trade returns ignore information about daily market returns over non-trading periods, it is not clear that it is theoretically superior to the lumped method»*.

In the literature[14] they have been proposed alternative methodologies so as to deal with the infrequent trading phenomenon. The most frequently used method is the *lumped returns method* which calculates daily returns from the stock price series and produces zero returns for non trading days & «*relatively large positive or negative returns on days when the stock trades*». This method underestimates the variance of returns and therefore biases the t-statistics used to test abnormal performance.

The *simple returns method*[15] calculates daily returns only for days for which stock prices are available. The daily abnormal return is obtained by subtracting the market return on these days. This method produces unbiased estimates of abnormal returns on the days calculated, but gives no information of returns on days with no trade. It may produce inconclusive outcomes regarding the event study if the number of days of no trade is quite long.

The *uniform returns method* calculates the daily returns between trading days and allocates the average daily return to each day for which trade does not occur. Therefore, the same stock return is allocated for all of the non trading days. This method performs about the same as lumped returns method.

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[14] See Bartholdy et al. (2007), p. 5-6 and Maynes & Ramsey (1993), p. 147-149.
[15] See Fotis & Polemis (2010a), p. 5,9.

However, even when returns are calculated on a trade to trade basis, there is a possibility that a high prevalence of zero returns may occur. Those zero returns are likely to lead to positive serial correlation in the return series. In that case, the trade to trade approach will only reduce, but not eliminate, the bias on findings towards the rejection of serial independence. In this paper the percentage of zero returns is low (<10% of the total number of observations).

4.2.2 The Estimated model

I estimate the average effect of five releases of public information (τ_1 = *down raids,* τ_2 = *Statement of Objections,* τ_3 = *Final Decision of HCC,* τ_4 = *Pre-final Court of Appeal Decision,* τ_5 = *Final Court of Appeal Decision*) on infringed firm's financial value. For this scope, I elaborate the following econometric model for each τ [16]

$$\overline{R}_{j,\tau} = a + \beta \overline{R}_{m,\tau} + \sum_{\tau=t_0}^{t_1} \gamma \Delta_{\tau,t} + AR(p) + \varepsilon_{\tau} \quad (4)$$

where $\overline{R}_{j,\tau} = \frac{\sum_{i=1}^{\kappa} R_{j,\tau}}{k}$, $j = 1.......\kappa$, the $\kappa * j's$ trade to trade stock returns of infringed firms at $\tau = 1...5$, $\overline{R}_{m,\tau} = \frac{\sum_{i=1}^{\kappa} R_{m,\tau}}{\kappa}$, the average return of market index of each j in the τ, $\Delta's$ are dummy variables assuming value 1 on date $\tau = t_0.....t_1$ and zero on $n-1$ dates prior to t_0 and $AR(p)$ is the autoregressive component of order p.

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[16] Except from τ_4 which I use OLS. See *Table A2-2 in Appendix 2*.

I estimate equation (4) for each τ over the combined period (T, T^*). *Each dummy variable coefficient corresponds to the average effect (residual) of* τ *on infringed firm's stock value.*

Equation (4) uses average stock returns of infringed firms of the specific τ. Despite the fact that the averaging is not over the same time points (i.e. different infringed firms from different antitrust & abuse of dominant position cases), the regression works quite well since the values of α & β in equation (4) are the same as the estimated values of equation (4) under the assumption of equally weighted portofolios (i.e. different infringed firms from the same antitrust & abuse of dominant position case)[17]. The null hypothesis of estimated model (4) is

$$H_{0,\tau} : \gamma' s = 0 \quad (5)$$

I use Ljung-Box *Q*-statistics so as to evaluate the null hypothesis that there is no autocorrelation in the residuals up to order p. In case of serially correlated residuals I estimate an AR(p) model. If the autoregressive model does not ameliorate the volatility in residuals I estimate a GARCH(1,1) model, which it has been found to capture adequately the stock return volatility clustering[18]. That is, a GARCH(1,1) model can be written as follows:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (6)$$

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[17] The underlying assumption behind that is that the $\beta' s$ estimates of each firm are not related to specific date return. So, following Pynnönen (2005), '*the covariation between them can be assumed to be approximately zero*'.

[18] Since the period around the release of public information from t_0 to t_1 does not include several days, it is feasible equation (6) to capture different volatility levels for different $t_0 \leq t' s \leq t_1$ without requiring large number o observations.

where σ_t^2 is the one-period ahead forecast variance based on past information (conditional variance), ε are the residuals from equation (4), ω the constant term of equation (6), ε_{t-1}^2 the ARCH – term and σ_{t-1}^2 the GARCH - term.

5 Results

5.1 Descriptive Statistics

Table A1-1 in Appendix 1 reports normality tests of average stock returns of infringed firms (the dependent variable of estimated equations) and market index (the, *inter alia*, independent variable of estimated equations). It is evident from the p-values of all tests that the normality assumption of stock returns cannot be rejected even at a=0,10 level of significance (except from market index return in τ_2 were the p-value of Jarque-Bera test is 0,06).

Tables A1-2 & A1-3 summarizes descriptive statistics of stock returns of infringed firms in both t_0- t_1 and t_o^* - $t_0 - 1$ periods. From both Tables we see that the mean of the average returns is higher in t_0- t_1 period than in t_o^* - $t_0 - 1$, but the difference is not statistically significant in terms of p-values of *Table A1-3*. The same picture holds for the estimated Standard Deviation of the average returns of involved firms. The difference in almost all cases ranges from 5% to 20% (except from average returns in τ_4). However, the specified difference is not statistically significant in 4 out of 5 $\tau's$ indicating that the stock returns of infringed firms in τ_2 may exhibit volatility effect due to the release of public information at date τ [19].

[19] I use GARCH(1,1) to estimate the effect of the release of public information at τ_2. See *Table A2-2 in Appendix 2*.

Table A2-1 in Appendix 2 reports normality tests of residuals of estimated equations. It is evident from the reported p-values of all tests that the normality assumption cannot be rejected even at a=0,10 level of significance.

5.2 Econometric results

Table A2-2 in Appendix 2 reports the econometric results from the estimation of equations (4) & (6). Table 2 summarizes the main findings of econometric estimations.

Table 2: Econometric Estimations from Regression Based Approach: Summary of results (%)

Cumulative Average Residual	Nonoverlapping steps of an antitrust & abuse of dominant position case* (τ_1)	(τ_2)	(τ_3)	(τ_4)	(τ_5)
$\tau = 0$	-0,09 (>0,10)	3,98 (>0,10)	**-2,94** (≤ 0,01)	-0,67 (>0,10)	**-2,16** (≤ 0,05)
$\tau = +5$	0,53 (>0,10)	4,18 (>0,10)	**-2,85** (≤ 0,01)	-1,56 (>0,10)	**-2,78** (≤ 0,05)

Source: Table A2-2, Appendix 2.

* τ_1 : Down raids , τ_2 :Statement of Objections , τ_3 : HCC Decision τ_4 : Pre – final Court of Appeal Decision , τ_5 : Final Court of Appeal Decision

p-values in parenthesis

On the one hand, during the '*Investigation Period'* the only statistically significant cumulative average effect on infringed firm's share price is τ_3, that is, the final decision of HCC. At $\tau = 0$ the issuing of the decision causes a 2,94% cumulative average drop in the infringed firm's share value, while the *overall average effect* ($\tau = +5$) causes a 2,85% cumulative average drop in the infringed firm's share value.

On the other hand, during the '*Deterrence Period*', the final decision of the Court of Appeal causes a statistically significant 2,16% in the share price of the infringed firms. The same picture holds at the date of the release of the public information

($\tau = 0$). The share price of the involved firms statistically decline 2,78%. Following Langus & Motta (2009), '*This implies a very quick rely of the news to the* investors'.

The release of τ_1, τ_2 & τ_4 does not cause a statistically significant effect (either negative or positive) in the infringed firm's share price during the t_o^* - $t_0 - 1$ period. Cumulative average residual on the day of the surprise inspection is *negative* but not statistically significant, suggesting a 0.01% drop in the firm's share price the date $\tau = 0$ where the dawn raid is carried out. The overall cumulative average effect is positive (0,53%), but not statistically significant.

Additionally, the temporal recall of the final decision of HCC (τ_4) causes an unstatistically significant negative effect in the share price of involved firms, either at date $\tau = 0$ or at date $\tau = +5$.

However, 4 days and 1 day prior to surprise inspection, the average residual is negative and statistical significant at the level of a=0,10 (see *Table A2-2 in Appendix 2*). The same picture we get 2 and 3 days after the down raid. Its effect is negative and positive and statistical significant at the level of a=0,10 respectively.

During the issuing of the final decision of HCC the average residual of involved firms is negative 5, 3 and 2 days prior the date $\tau = 0$. That may indicate a negative decision of HCC was expected by the financial investors.

Moreover, during the t_0- t_1 period of τ_2, the average residual of infringed firms is positive and statistical significant at the level of a=0,01 five and two dates prior the issuing of the Statement of Objections by the GDC of HCC. Also, the same holds for the average residual of involved firms during the t_0- t_1 period of τ_4. At date $\tau = +4$, the average residual causes a statistically significant at the level a=0,01 negative effect of -2,91% in the share price of infringed firms.

Table A2-2 in Appendix 2 also reports diagnostic tests and equality tests of the variance of residuals. The results of diagnostic tests imply that the final method of estimation *fix* the volatility effect in the residuals. The latter can be verified by the p-value of the equality tests of residual's variance between the t_0- t_1 & t_o^* - $t_0 - 1$ periods. In all cases we reject the null hypothesis of statistically significant difference between the aforementioned residual's variance.

6 Concluding remarks and further research

In this paper I assume the following public information which may affect the share price of the infringed firms: a) the down raids, b) the issue of the Statement of Objection, c) the final Decision of the HCC and the Court Decisions. The first three constitutes the '*Investigation period*' and the last two constitute the '*Deterrence period*'. I use *aggregate regression based approach* to evaluate the effect of the release of the abovementioned public information in the share price of the firms which infringe articles 1 & 2 of Greek Competition Law. Especially, I estimate a dummy variable model with autoregressive components of order p and a GARCH (1,1) model in case where volatility effect persists in the residuals for each release of public information.

The econometric estimations suggest that during the '*Investigation Period*' and the '*Deterrence Period*', the cumulative average residuals of the infringed firms drop by -2,85% and -2,78% respectively. Therefore, I state that the release of the final decisions of the HCC and the Court of Appeal, negatively affect the share price of the infringed firms. Despite the fact that I do not get statistically significant cumulative average results during the release of τ_1, τ_2 & τ_4, there are average residuals prior and after the release of the public information which are statistically significant.

In this paper I discuss mainly the aggregate regression based approach. However, firm level analysis may also be desirable so as to capture the effect of the public information on the infringed firm's share price. For this scope, equation (4) in conjunction with Boehmer et al. (1991) t-test may be used for single firm analysis. Weighted Least Squares (WLS) with robust standard errors and maximum likelihood estimation (MLE) with non-proportional heteroscedasticity may be useful supplements to OLS with robust standard errors[20]. Also, quantitative event study may be a useful extension of this paper[21].

References

Bartholdy, J. Olson, D. Peare, P., (2007), Conducting Event Studies on a Small Stock Exchange, European Journal of Finance, 13 (3), 227-252.

Bittlingmayer, G., and Hazlett, T.W., (2000), DOS Kapital: Has Antitrust Action Against Microsoft Created Value in the Computer Industry?, Journal of Financial Economics, 55, 329-359.

Bizjak, J., and Coles, J.L., (1995), The Effect of Private Antitrust Litigation on the Stock-Market Valuation of the Firm, American Economic Review, 85, 436-461.

Bosch, J.C., Eckard, E.W. (1991). The Profitability of Price Fixing: Evidence from Stock Market Reaction to Federal Indictments. Review of Economics and Statistics, 73, 309-17.

[20] See Pynnönen (2005), p. 339 and the references therein.
[21] See Schwert (1991) for this kind of method.

Burns, M.R., (1977). The Competitive Effect of Trust-Busting: A Portfolio Analysis, Journal of Political Economy, 85, 717-39.

Detre, J.D., Golub, A., and Connor, J.M. (2005). The profitability of price fixing: Have stronger antitrust sanctions deterred?, Presented at the International Organization Conference 3, Atlanta, Georgia, April 8-9, 2005.

De Vany, A., and McMillan, H., (2004), Was the Antitrust Action that Broke Up the Movie Studios Good for Movies? Evidence from the Stock Market, American Law and Economics Review, 6, 135-53.

Fotis, P. Polemis, M. Zevgolis, N. (2011). Robust event studies for derogation from suspension of concentrations in Greece during the period 1995-2008, Journal of Industry Competition & Trade, 11 (1), 67-89.

Fotis, P., Polemis, M., (2010a). Are mergers and acquisitions competitive in specific Greek relevant markets? Evidence from small stock exchange*,* Presented at Fifth Annual Competition and Regulation European Summer School and Conference, **ADVANCES** IN THE ANALYSIS OF COMPETITION POLICY AND REGULATION, *(CRESSE 2010)*, Chania, Greece.

Garbade, K.D., Silber, W.J., and White, L.J. (1982). Market Reaction to the Filing of Antitrust Suits: An Aggregate and Cross-Sectional Analysis, Review of Economics and Statistics, 64, 686-91.

Gilligan, T.W., (1986), The Competitive Effects of Resale Price Maintenance, RAND Journal of Economics, 17, 544-56.

Günster, A., Mathijs, A.V., (2010). The Impact of European Antitrust Policy: Evidence from the Stock Market, available at Dijkhttp://papers.ssrn.com/sol3/papers-.cfm?abstract_id=1598387

Langus, G., Motta, M. (2009). On the Effect of EU Antitrust Investigations and Fines on Infringing Firms' Market Value. in C.-D. Ehlermann and I. Atanasiu (eds.), *Enforcement of Prohibition of Cartels*, Hart Publishing.

Maynes, E. Rumsey, J. (1993). Conducting event studies with thinly traded stocks, Journal of Banking and Finance, 17, 145-157.

Pynnönen, S., (2005). On regression based event study. *Acta Wasaensia,* 143: 327-354.

Schwert, G, W., (1981), Using financial data to measure the effect of regulation, Journal of Law and Economics, 24, 121—157.

Appendix 1

Table A1-1: Normality Tests

Returns: τ_1

	Firm	Market Index
Jarque-Bera Test	3,26 (0,20)	3,15 (0,31)
Lilliefors	0,04 (>0,10)	0,03 (>0,10)
Cramer-von Mises	0,05 (0,53)	0,04 (0,70)
Watson	0,05 (0,51)	0,04 (0,65)
Anderson-Darling	0,40 (0,36)	0,26 (0,71)

Returns: τ_2

	Firm	Market Index
Jarque-Bera Test	3,52 (0,17)	3,86 (0,06)
Lilliefors	0,03 (>0,10)	0,05 (>0,10)
Cramer-von Mises	0,05 (0,54)	0,10 (0,12)
Watson	0,05 (0,50)	0,09 (0,13)
Anderson-Darling	0,35 (0,48)	0,71 (0,07)

Returns: τ_3

	Firm	Market Index
Jarque-Bera Test	0,76 (0,68)	0,19 (0,90)
Lilliefors	0,03 (>0,10)	0,03 (>0,10)
Cramer-von Mises	0,02 (0,92)	0,02 (0,97)
Watson	0,02 (0,92)	0,02 (0,97)
Anderson-Darling	0,14 (0,98)	0,16 (0,96)

Returns: τ_4

	Firm	Market Index
Jarque-Bera Test	1,05 (0,59)	1,51 (0,47)
Lilliefors	0,03 (>0,10)	0,03 (>0,10)
Cramer-von Mises	0,04 (0,75)	0,03 (0,83)
Watson	0,03 (0,75)	0,03 (0,85)
Anderson-Darling	0,25 (0,75)	0,19 (0,90)

Returns: τ_5

	Firm	Market Index
Jarque-Bera Test	1,60 (0,45)	4,62 (0,10)
Lilliefors	0,03 (>0,10)	0,04 (>0,10)
Cramer-von Mises	0,03 (0,82)	0,07 (0,25)
Watson	0,03 (0,79)	0,07 (0,27)
Anderson-Darling	0,22 (0,82)	0,46 (0,26)

Source: Author's Elaboration of Data

a=0,10 (p-value<0,10) a=0,05 (p-value<0,5) a=0,01 (p-value<0,01)

p-value in parenthesis.

τ_1 : Down raids , τ_2 :Statement of Objections , τ_3 : HCC Decision τ_4 : Pre – final Court of Appeal Decision ,

τ_5 : Final Court of Appeal Decision

Table A1-2: Descriptive Statistics

Sample Statistics: τ_1*

	Mean	Std	Skew.	Kurt.	Obs.
t_0 - t_1 Period	-0,01	0,6	1,5	4,44	11
t_o^* - $t_0 - 1$ Period	0,11	0,47	-0,12	3,43	300
Total	0,11	0,47	-0,12	3,44	311

Sample Statistics: τ_2*

	Mean	Std	Skew.	Kurt.	Obs.
t_0 - t_1 Period	-0,2	0,84	-1,31	4,02	11
t_o^* - $t_0 - 1$ Period	0,02	0,8	0,06	3,45	300
Total	0,02	0,8	0,01	3,52	311

Sample Statistics: τ_3*

	Mean	Std	Skew.	Kurt.	Obs.
t_0 - t_1 Period	-0,2	0,87	-0,5	2,63	11
t_o^* - $t_0 - 1$ Period	0,05	0,67	0,16	3,08	300
Total	0,04	0,67	0,1	3,15	311

Sample Statistics: τ_4*

	Mean	Std	Skew.	Kurt.	Obs.
t_0 - t_1 Period	-0,36	0,6	-1,68	5,6	11
t_o^* - $t_0 - 1$ Period	-0,01	0,64	-0,1	2,98	300
Total	-0,01	0,64	-0,13	3,12	311

Sample Statistics: τ_5*

	Mean	Std	Skew.	Kurt.	Obs.
t_0 - t_1 Period	-0,47	0,62	0,002	2	11`
t_o^* - $t_0 - 1$ Period	-0,01	0,58	0,07	3,38	300
Total	-0,03	0,59	0,04	3,34	311

Source: Author's Elaboration of Data
*See Table A1-1

Table A1-3: Equality Tests

Equality tests of means and variances in t_0 - t_1 , t_o^* - $t_0 - 1$ Periods

Returns: τ_1 *

	Means^	Variances^^
t-Test	2,18	4,42
p-Value	0,17	0,1

Returns: τ_2 *

	Means^	Variances^^
t-Test	0,83	80,19
p-Value	0,58	0,00

Returns: τ_3 *

	Means^	Variances^^
t-Test	1,93	1,57
p-Value	0,21	0,27

Returns: τ_4 *

	Means^	Variances^^
t-Test	1,47	3,22
p-Value	0,32	0,09

Returns: τ_5 *

	Means^^	Variances^^
t-Test	2,92	3,45
p-Value	0,21	0,08

Source: Author's Elaboration of Data

a=0,10 (p-value<0,10) a=0,05 (p-value<0,5) a=0,01 (p-value<0,01)

^F-Anova test ^^Welch F-test

*See Table A1-1

Appendix 2

Table A2-1: Normality Tests (Residuals) Regression Based Approach

Residuals: Down raids	
	AR(4)
Jarque-Bera Test	0,74 (0,69)
Residuals: Statement of Objections	
	GARCH(1,1)
Jarque-Bera Test	1,84 (0,40)
Residuals: HCC Decision	
	AR(8)
Jarque-Bera Test	2,65 (0,27)
Residuals: Court Decision 1	
	OLS
Jarque-Bera Test	1,06 (0,59)
Residuals: Court Decision 2	
	AR(2)
Jarque-Bera Test	1,19 (0,55)

Source: Author's Elaboration of Data

a=0,10 (p-value<0,10) a=0,05 (p-value<0,5) a=0,01 (p-value<0,01)

p-value in parenthesis.

Table A2-2: Coefficient Estimates: Regression Based Approach

- τ_1 - AR(4)

Coefficients	AR^	Std (AR)	t-AR	p-value	CAR^^	Std(CAR)	t-CAR	p-value^^^
a	0,07	0,03	2,61	**0,01**				
R_m	0,72	0,08	9,50	**0,00**				
AR(4)	0,13	0,06	2,29	**0,02**				
D-5	-0,48	0,41	-1,17	0,24	-0,48	0,41	-1,17	
D-4	0,68	0,41	-1,66	**0,09**	0,20	0,58	0,34	
D-3	0,13	0,41	0,32	0,75	0,33	0,71	0,46	
D-2	-0,27	0,41	-0,65	0,51	0,06	0,82	0,07	
D-1	-0,70	0,41	-1,68	**0,09**	-0,64	0,92	-0,70	
D 0	0,55	0,42	1,30	0,19	-0,09	1,03	-0,09	>0,10
D+1	0,54	0,41	1,31	0,19	0,45	1,08	0,41	
D+2	-1,09	0,42	-2,62	**0,01**	-0,64	1,19	-0,54	
D+3	0,97	0,42	2,34	**0,02**	0,33	1,26	0,26	
D+4	0,36	0,41	0,88	0,38	0,69	1,30	0,53	
D+5	0,03	0,41	0,07	0,94	0,72	1,36	0,53	

Diagnostic Statistics (Ljung-Box Q-statistic)

	Stat	p-value
Q (4) residual	2,99	0,4
Q (4) residual^2	0,86	0,84

p-value for F test for equality of event and non event residual variances (Brown-Forsythe statistic)

p-value
0,42

Table A2-2: (*continued*)

- τ_3 - AR(8)

Coefficients	AR^	Std (AR)	t-AR	p-value	CAR^^	Std(CAR)	t-CAR	p-value^^^
a	0,06	0,03	1,87	**0,06**				
R_m	0,37	0,07	5,05	**0,00**				
D-5	-2,17	0,63	-3,43	**0,00**	-2,17	0,63	-3,44	
D-4	-0,12	0,64	-0,20	0,84	-2,29	0,91	-2,53	
D-3	-0,67	0,63	-3,43	**0,00**	-2,96	1,09	-2,71	
D-2	-1,11	0,63	-1,76	**0,08**	-4,07	1,26	-3,23	
D-1	-0,07	0,63	-0,10	0,92	-4,14	1,41	-2,94	
D 0	-0,39	0,63	-0,61	0,54	-4,53	1,54	-2,94	≤ 0,01
D+1	-0,51	0,63	-0,80	0,42	-5,04	1,67	-3,02	
D+2	-0,42	0,63	0,67	0,50	-5,46	1,78	-3,06	
D+3	-0,74	0,64	-1,16	0,25	-6,20	1,92	-3,23	
D+4	0,69	0,64	1,08	0,28	-5,51	2,02	-2,72	
D+5	-0,53	0,64	-0,83	0,41	-6,04	2,12	-2,85	
AR(8)	-0,15	0,06	-2,59	**0,01**				

Diagnostic Statistics (Ljung-Box Q-statistic)

	Stat	p-value
Q (4) residual	8,68	0,28
Q (4) residual^2	5,40	0,61

p-value of F test for equality of event and non event residual variances (Brown-Forsythe statistic)

p-value
0,41

Table A2-2: (*continued*)

- τ_2 - GARCH(1,1)

Coefficients	AR^	Std (AR)	t-AR	p-value	CAR^^	Std(CAR)	t-CAR	p-value^^^
a	0,04	0,07	0,86	0,39				
R_m	0,59	0,07	8,34	**0,00**				
D-5	1,68	0,40	4,43	**0,00**	1,68	0,40	4,20	**0,00**
D-4	-0,55	3,79	-0,15	0,88	1,13	5,36	0,21	>0,10
D-3	0,10	0,42	0,25	0,80	1,23	0,73	1,69	**0,09**
D-2	2,62	0,41	6,35	**0,00**	3,85	0,82	4,70	**0,00**
D-1	-0,35	5,68	-0,06	0,95	3,50	12,70	0,28	>0,10
D 0	0,48	3,29	0,15	0,88	3,98	8,06	0,49	>0,10
D+1	0,79	0,59	1,34	0,18	4,77	1,56	3,06	**0,00**
D+2	0,95	5,14	0,18	0,85	5,72	14,54	0,39	>0,10
D+3	-0,34	1,27	-0,27	0,79	5,38	3,81	1,41	>0,10
D+4	-0,03	72,14	0,00	0,99	5,35	228,13	0,02	>0,10
D+5	-1,17	1,60	-0,70	0,47	4,18	5,31	0,79	>0,10
AR(4)	0,15	0,05	2,83	**0,00**				
Variance Equation								
	Coef	**Std (AR)**	**t-value**	**p-value**				
Constant	0,20	0,14	1,45	0,15				
ARCH	0,13	0,07	1,74	0,08				
GARCH	1,45	0,32	1,42	0,15				
Diagnostic Statistics (Ljung-Box Q-statistic)								
	Stat	**p-value**						
Q (4) residual	2,00	0,57						
Q (4) residual^2	3,00	0,40						
p-value of F test for equality of event and non event residual variances (Brown-Forsythe statistic)								
		p-value						
		0,83						

- τ_4 - OLS (*Table A2-2 continued*)

a	0,02	0,04	0,48	0,63				
R_m	0,42	0,09	4,89	**0,00**				
D-5	-0,41	0,62	-0,66	0,51	-0,41	0,62	-0,66	
D-4	0,37	0,62	0,60	0,55	-0,04	0,88	-0,05	
D-3	-0,49	-0,62	-0,80	0,42	-0,53	-1,07	0,49	
D-2	0,29	0,62	0,47	0,64	-0,24	1,24	-0,19	
D-1	-0,38	0,62	-0,62	0,53	-0,62	1,39	-0,45	
D 0	-0,40	0,62	-0,65	0,51	-1,02	1,52	-0,67	>0,10
D+1	0,00	0,62	0,00	0,99	-1,02	1,64	-0,62	
D+2	0,03	0,62	-0,05	0,96	-0,99	1,75	-0,56	
D+3	-0,19	0,62	-0,31	0,75	-1,18	1,86	-0,63	
D+4	-1,79	0,62	-2,91	**0,00**	-2,97	1,96	-1,51	
D+5	-0,19	0,61	-0,32	0,75	-3,16	2,02	-1,56	

Diagnostic Statistics (Ljung-Box Q-statistic)

	Stat	**p-value**
Q (until 12 lags) residual		>0,10
Q (until 36 lags) residual^2		>0,30

F test for equality of event and non event residual variances (Brown-Forsythe statistic)

p-value
0,71

- τ_5 - AR(2)

a	0,02	0,04	0,64	0,52				
R_m	0,41	0,06	7,17	**0,00**				
AR(2)	0,18	0,06	3,09	**0,00**				
D-5	0,11	0,54	0,20	0,84	0,11	0,54	0,20	
D-4	-1,08	0,54	-2,00	**0,05**	-0,97	0,76	-1,27	>=0,10
D-3	-0,37	0,55	-0,67	0,50	-1,34	0,95	-1,41	
D-2	-0,86	0,55	-1,57	0,11	-2,20	1,10	-2,00	$\leq$0,05
D-1	0,55	0,55	1,00	0,32	-1,65	1,23	-1,34	>=0,10
D 0	-1,26	0,55	-2,30	**0,02**	-2,91	1,35	-2,16	
D+1	0,12	0,55	0,23	0,82	-2,79	1,46	-1,92	
D+2	-0,32	0,55	-0,56	0,57	-3,11	1,56	-2,00	$\leq$0,05
D+3	-0,31	0,55	-0,56	0,58	-3,42	1,65	-2,07	
D+4	-1,45	0,55	-2,65	**0,01**	-4,87	1,74	-2,80	
D+5	-0,20	0,55	-0,36	0,72	-5,07	1,82	-2,78	

Diagnostic Statistics (Ljung-Box Q-statistic)

	Stat	**p-value**
Q (2) residual	1,04	0,31
Q (2) residual^2	0,72	0,40

p-value of F test for equality of event and non event residual variances (Brown-Forsythe statistic)

p-value
0,10

Source: Author's Elaboration of Data, a=0,10 (p-value<0,10) a=0,05 (p-value<0,5) a=0,01 (p-value<0,01)

^Average Residual ^^Cumulative Average Residual ^^^ (two - tailed) - Degrees of Freedom: 298