Intervalling-effect bias and evidences for competition policy

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Abstract

The purpose of this paper is on the one hand to analyze whether the security's systematic risk beta estimates change as the infrequent trading phenomenon appears and on the other hand to provide useful insight on the impact of mergers and acquisitions on competition policy. The paper employs the models of Scholes and Williams (1977), Dimson (1979), Cohen et al. (1983a) and Maynes and Rumsey (1993) on a small stock exchange with thickly infrequent trading stocks. The empirical results reveal that for some securities the models employed by Scholes and Williams (1977) and Cohen et al. (1983a) improve the biasness of the Ordinary Least Squares Market Model (Maynes and Rumsey, 1993). Regarding competition policy issues, we argue that competitors gain while merged entities loose or at least do not gain from the clearness of the mergers under scrutiny. However, if we focus our attention on each individual merger, the results are rather controversial.

Key words: Intervalling-effect bias, Beta risk measurement, infrequent trading phenomenon, mergers and acquisitions, competition policy

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1. INTRODUCTION

The *intervalling-effect bias* in security's beta estimates denotes the sensitivity of the beta to the length of the interval return (daily, monthly or yearly). Empirically, estimated beta values are systematically changed as the return interval is varied if Independent and Identically Distributed (IID) additive assumption is violated.[1] The seminal paper examining *intervalling-effect bias* is attributed to Fama (1970).

Scholes and Williams (1977) and Dimson (1979) addressed the *intervalling-effect bias* slightly differently and showed the bias in beta caused by *infrequent trading phenomenon*. The latter 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 is positively correlated with their trade frequency.

The link between the security's beta estimates and inferences for competition policy has also been explored in the literature. According to this link critical role plays the movement of securities' residuals during the examined time interval which is affected by the event under scrutiny. If the event constitutes an announcement or a notification of a Mergers & Acquisitions (M&As), a researcher has the ability to inference potential *anti or pro competitive effects* of the scrutinized M&As. Cox and Portes (1998) portray a detailed clarification of the competitive outcomes for M&As with *infrequent trading phenomenon*.

In the literature there is a vast majority of articles which deal with the above mentioned research areas. In particular and regarding the *intervalling-effect bias* in security's beta estimates, Hong and Satchell (2014) examine Capital Asset Pricing Model (CAPM) with correlated errors with exogenous factors and consider the evaluation of betas on current time. The authors show, *inter alia*, that by modelling the *intervalling effect bias* as the Ornstein-Uhlenbeck process produces extremely good results for short time intervals. They also show that beta estimates are monotonic to time interval and estimate a critical value of beta below which the latter is underestimated, but the bias is decreasing above this critical value which the beta is overestimated as the time interval increases. Milonas and Rompotis (2013) show that small cap Exchange Traded Funds (ETFs) have greater betas than large cap ETFs, while Ordinary Least Square (OLS) beta of all the ETFs increases as the interval return is lengthened regardless of the degree of capitalization.

The most commonly empirical models which are dealing with *infrequent trading phenomenon* are attributed to Cohen et al. (1983a) and the Market Model by Maynes and Rumsey (1993). Armitage and Brzeszczynski (2011) argue that OLS method tends to overestimate the beta coefficients than the ARCH models. Sercu, Vanderbroek and Vinaimont (2008) find that OLS exhibits the highest bias and lowest standard errors, while the model proposed by Scholes and Whilliams (1977) delivers the lowest bias and the highest standard errors.

Diacogiannis and Makri (2008) examine with OLS the *intervalling effect bias* for a number of thinly traded securities on the Athens Stock Exchange (ASE) and conclude that the bias appears.[2] They also compare the beta estimates which are derived from the Scholes and Williams (1977) and Cohen et al. (1983a) models with those from the market model of Maynes and Rumsey (1993) and state that there are no statistically significant differences between the mean beta estimates.[3]

As it concerns the literature which deals with the link between the security's beta estimates and the anti or pro competitive effects of M&As, Rahim and Pok (2013) explore the short – run wealth effects of merger and acquisitions announcements in Malaysia during the period from 2001 to 2009. They find positive market reactions for both targets and bidding firms. Fotis and Polemis (2012a) find mixed results by investigating the short – run effects of critical mergers in Greece the last decade, while Fotis, Polemis and Zevgolis (2011) examine 13 requested derogations from suspension during the period 1995–2008 by applying and assessing the results of three different methodologies (market model, mean adjusted return model and market adjusted return model). They found that the average abnormal and cumulative returns of the requested firms are positive and statistical significant.

Furthermore, Duso, Gugler and Yurtoglou (2010) infer that a long time window around the announcement merger date (25 or 50 days prior to the event) increases the ability to capture mergers' ex - post profitability by using accounting data. In this finding also concludes the study of Mueller (1980). Bharba (2008) infers that potential mergers (i.e firms that subsequently receive bids), experience a statistically significant wealth gain estimated to 0.59% over the three day event window, while in the papers by Duso, Neven and Röller (2007) and Aktas, de Bodt and Roll (2007) it is thoroughly investigated the pro competitive and anti competitive effects of mergers and acquisitions under the European merger control regime.[4]

This paper relates to the above mentioned strands of the literature. Unlike other similar studies (Vazakides 2006; Diacogiannis and Makri 2008), it provides useful insight on the impact of M&As on competition policy by investigating four critical phase-II M&As cleared by the Hellenic Competition Commission (HCC) from 2006 to 2011.[5]

The novelty of this paper lies in the fact that a variety of issues related to the *intervalling effect bias* is thoroughly examined within a small market such as the ASE, while this examination is conducted during its evolution to maturity. The main reason for choosing the ASE as our benchmark is that it can be characterised as a small emerging market which during the examined period it experienced a huge fall of share prices and thus a considerable number of infrequent trading securities have emerged.

The remainder of this paper is organized as follows. Section 2 presents the sample selection and the research methodology. Section 3 encapsulates the main findings of our analysis, while section 4 concludes the paper. In the Appendix we present the derivation of the employed econometric models.

2. SAMPLE SELECTION AND MODEL SPECIFICATION

The sample consists of 22 companies listed in the ASE (three merged entities and 19 competitors) that were active in four phase-II M&As in Greece during the period 2006-2011. The said M&As took place in the oil and energy markets as well as in the paper and food industries.[6]

The sample securities exhibit a thick infrequent trading phenomenon. Following Barthdoly, Olson and Peare (2007) this means that they trade more than 80 of trading days or an average of than four days per week. Moreover, a medium traded security trades between 40 - 80 and a thin traded security trades less than 40 days per year.

We utilise the methodologies proposed by Scholes and Williams (1977), Dimson (1979), Cohen et al. (1983a) and the market model with simple returns[7] in order to measure the securities' beta systematic risk of the scrutinized sample of firms.[8] We use the simple return approach of the market model due to the fact that the crucial interval which we use in order to assess the competitive effects of the M&As on firm's stock value is almost unaffected by the missing days. That is, the average trading frequency and the number of days between transactions in the time interval are quite high and low respectively. Also, this approach produces unbiased estimates of residuals on the days calculated.[9]

Following the derivation of the econometric models in Appendix and in order to draw some inferences about the validity of the four different methodologies presented there, we use daily security returns and we calculate the mean beta for each firm (merged entity and competitors) evolved in every single phase-II M&A. The differences between the various methodologies are based on the selection of leads and lags and whether the values of the beta coefficients are estimated simultaneously or independently.

Scholes and Williams (1977) propose the inclusion of only one lag and one lead, while the Dimson (1979) and Cohen et al. (1983a) methodologies are based on the inclusion of many leads and lags in the estimation of the market returns. Further, Dimson's model calculates beta coefficient simultaneously, while in Scholes and Williams and Cohen et al. (1983a) models beta coefficients are estimated independently. To give an example, when we apply the Dimson's model, the beta coefficient is estimated by aggregating the slope coefficients of the following regression:

$$R_{j,t} = a + \sum_{\phi=-L}^{+L} \beta_{j,t+\phi} R_{m,t+\phi} + \varepsilon_{j,t} \tag{1}$$

On the contrary, the market model does not incorporate lagged and leaded values of market returns and utilises the OLS methodology to estimate the beta coefficient (see equation 1 in the Appendix).

If we allow for the usual assumptions of randomly and independently samples derived from normally distributed populations, then we employ a two tailed pooled variance t – test in order to examine whether the difference between their means is statistically significant. The t – test can be computed as $t = \frac{(\overline{X_1} - \overline{X_2}) - (\mu_1 - \mu_2)}{\sqrt{S_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$

where $S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{(n_1 - 1) + (n_2 - 1)}$ is the pooled variance, $\overline{X_1}$ is the mean of sample

1, $\overline{X_2}$ is the mean of sample 2, μ_1 is the mean of population1, μ_2 is the mean of population 2, n_1 is the size of sample 1, n_2 is the size of sample 2. The t – test follows a *t* distribution with $n_1 + n_2 - 2$ degrees of freedom.

To test the hypothesis of no difference in the means of two independent populations, the null hypothesis is $H_0 : \mu_1 - \mu_2 = 0$ or $\mu_1 = \mu_2$, against the alternative hypothesis that the means are not the same, that is, $H_1 : \mu_1 - \mu_2 \neq 0$ or $\mu_1 \neq \mu_2$.

3. EMPIRICAL RESULTS

3.1 Systematic risk estimates under thickly traded securities

Table 1 illustrates the difference between the mean beta generated by the market model and the mean beta provided by employing the models of Scholes and Williams (1977), Dimson (1979) and Cohen et al. (1983a). The beta estimations for each firm are derived from the equations (1), (2), (4) and (6) in the Appendix.

Table 1: Pooled variance t – tests of equality of means of beta estimations

t- statistics	$\overline{\beta^S} = \overline{\beta^{S-W,-1+1}}$	$\overline{\beta^S} = \overline{\beta^{D,-5+5}}$	$\overline{\beta^S} = \overline{\beta^{C,-2+2}}$	$\overline{\beta^S} = \overline{\beta^{C,-3+3}}$	$\overline{\beta^S} = \overline{\beta^{C,-4+4}}$
Phase – II Merger 1	1,06	2,06	2,42** (0,04)	2,08	2,26
Phase – II Merger 2	0,68	2,20	0,67	0,67	0,67
Phase – II Merger 3	-0,37	1,04	3,11** (0,009)	3,31** (0,006)	3,89** (0,002)
Phase – II Merger 4	2,28** (0,04)	1,83	2,45** (0,03)	2,36** (0,04)	2,51** (0,03)

Notes:
(**) = statistical significant at $\alpha = 0{,}05$ (p – values in parenthesis)
$\overline{\beta^S}$: mean value of beta coefficients derived from simple return approach of market model, $\overline{\beta^{S-W,-1+1}}$: mean value of beta coefficients derived from Scholes and Williams (1977) model, $\overline{\beta^{D,-5+5}}$: mean value of beta coefficients derived from Dimson (1979) model, $\overline{\beta^{C,-2+2}}$: mean value of beta coefficients derived from Cohen *et al.,* (1983a) model with 2 leads and lags, $\overline{\beta^{C,-3+3}}$: mean value of beta coefficients derived from Cohen *et al.*, (1983a) model with 3 leads and lags, $\overline{\beta^{C,-4+4}}$: mean value of beta coefficients derived from Cohen *et al.*, (1983a) model with 4 leads and lags
Source: Authors' elaboration of estimated securities' data

From the relevant table it is evident that the null hypothesis is rejected for some phase – II mergers at $\alpha = 0{,}05$ level of significance (the difference between the mean beta estimated using the simple return approach of market model and the mean beta obtained using the alternative models for each security is statistically significant). Particularly, regarding the phase – II merger 1, the difference between the mean beta coefficient from the market model and the mean beta generated by the Cohen et al. (1983a) model with two leads and lags is statistically significant.

Table 1 also portrays that the models proposed by Scholes and Williams (1977) and Cohen et al. (1983a) improve the biasness of the OLS method (market model) for phase – II mergers 3 & 4. Regarding phase – II mergers 1 & 2the difference between the mean beta coefficients estimated by using the simple return approach of the market model and the mean beta coefficient obtained using the alternative models is statistically insignificant.[10]

The empirical results for phase – II mergers 3 & 4 contradict the results obtained by the study of Diacogiannis and Makri (2008). They state that for both low and mid cap securities the methods of Scholes and Williams (1977) and Cohen et al. (1983a) do not improve the biasness of the OLS method and conclude that the OLS method is appropriate for beta estimation when the infrequently traded phenomenon is present.

3.2 Ex-post evaluation of competition policy for M&As under thickly infrequent trading securities

In this section we proceed to an ex – post evaluation of the four phase – II mergers in order to draw some useful insights regarding competition policy. For this purpose and following the analysis of the previous section we utilize equation (1) in the Appendix for phase – II M&As 1 & 2 and equations (3) and (7) in the Appendix for phase – II M&As 3 & 4. Equation (7) is estimated with four leads and lags of market returns.[11]

Phase – II M&As 1, and 3 consist of firms that are competitors either in horizontal or in vertical level. The firms in phase – II M&As 2 and 4 are not direct competitors since they are active in neighborhood product markets. Therefore, we group the firms into different levels of competitive interaction so that to infer accurate conclusions of competition policy for M&As.

We define various time intervals from one day prior the announcement of the M&A until the day of the decision of the HCC. Day 0, denotes the date of: a) the announcement, b) notification, c) the phase-II decision and d) the date of clearness of the M&A. Short – run time intervals are those that span until 20 trading days before and after each Day 0. Long – run time intervals are those that span from 1 trading day before the announcement until the trading day of the clearness of the M&A (from 52 to 68 trading days).

We use standard literature so as to calculate Average Abnormal Residual (AAR_{jt}), Cumulative Average Abnormal Residual ($CAAR_{jt}$) and Cumulative Abnormal Residual (CAR_{jt}) of security *j* at period *t*. Thus $AAR_{jt} = \frac{\sum_j AR_{jt}}{n}$, where n is the number of the sample securities and $AR_{jt} = R_{jt} - \hat{R}_{jt}$ are the abnormal residuals, where R_{jt} is the actual return of security *j* at period *t* and $\hat{R}_{jt}$ is the estimated return derived from equations (1), (3) and (7) in the Appendix. $CAAR_{jt} = \sum_{t=-m}^{+n} AAR_{jt}$, where m is the first day of the time interval and n its last day and $CAR_{jt} = \sum_{t=-m}^{+n} AR_{jt}$.[12]

We estimate the econometric models over 200 trading days, starting 2 days prior to the various time intervals. For simple return approach of market model the estimation interval of the econometric models is greater than a calendar year.

Table 2 elaborates the short – run competitive effects of the whole sample of M&As.

Table 2: The competitive effects of M&As: evidence from the whole sample (%)

Method	**Merger announcement**	**All Firms**		**Competitors**		**Merged firms**	
		AAR	**CAAR**	**AAR**	**CAAR**	**AAR**	**CAAR**
$R^{S}_{j,t}$	-1 +1	1,29*	1,13	1,33*	0,96	1,04	2,22*
	-5 +5	-0,36	-0,40	-0,42	-0,56	0,00	0,62*
	-10 +10	0,53*	0,07*	0,64*	0,04	-0, 16	0,20
	-15 +15	-0,20	0,49	-0,23	0,46	-0,01	0,71
	-20 +20	0,05	0,07	0,04	0,03	0,08	0,28
$R^{S-W}_{j,t}$	-1 +1	0,92*	0,47	1,08*	0,53	-0,10	0,13
	-5 +5	-0,17	-0,45	-0,20	-0,63	0,05	0,71***
	-10 +10	0,49	-0,71	0,58	-0,88	-0,11	0,41
	-15 +15	-0,11	0,27	-0,13	0,14	0,03	1,11***
	-20 +20	0,08	-0,66	0,07	-0,92	0,11	0,95
$R^{C}_{j,t}$	-1 +1	-‡	-‡	-‡	-‡	-0,13	0,05
	-5 +5	-‡	-‡	-‡	-‡	0,04	0,58*
	-10 +10	-‡	-‡	-‡	-‡	-0,12	0,10
	-15 +15	-‡	-‡	-‡	-‡	0,04	0,70
	-20 +20	-‡	-‡	-‡	-‡	0,10	0,45
Method	**Merger notification**	**AAR**	**CAAR**	**AAR**	**CAAR**	**AAR**	**CAAR**
$R^{S}_{j,t}$	-1 +1	-0,41	0,23	-0,42	0,24	-0,51**	-0,78***
$R^{S-W}_{j,t}$	-1 +1	-0,13	0,46	-0,14	0,48	0,07**	0,27***
	Phase-II decision	**AAR**	**CAAR**	**AAR**	**CAAR**	**AAR**	**CAAR**
$R^{S}_{j,t}$	-1 +1	-0,79***	-0,81	-0,81***	-0,76	-0,70**	-1,16*
$R^{S-W}_{j,t}$	-1+1	-0,94*	-1,10	-1,09*	-1,29	0,05	0,10
	Date of Clearness	**AAR**	**CAAR**	**AAR**	**CAAR**	**AAR**	**CAAR**
$R^{S}_{j,t}$	-1 +1	0,68	0,62***	0,48***	0,67	-0,13	-0,13
$R^{S-W}_{j,t}$	-1+1	0,75**	0,95	0,55***	1,01***	-0,55**	-0,82*

Notes:
‡ Even though the results from the Cohen *et al.*, (1983a) model are positive, are not applicable for the purpose of competition policy. The same results we get from all time intervals.
(*) = statistical significant at $\alpha = 0{,}10$, (**) = statistical significant at $\alpha = 0{,}05$, (***) = statistical significant at $\alpha = 0{,}01$.
Source: Authors' elaboration of estimated securities' data

From the relevant table, it is evident that the CAAR of both the merged firms and their rivals around the merger announcement shows a positive trend for almost all of the time intervals. This outcome constitutes an indication that investors expected the mergers to be profitable for the rival firms. Duso et al. (2010) have also derived the same outcome for a sample of large mergers in the European Union during the period 1990 to 2001.

If we restrict our attention to the three days time interval around the merger notification (-1 +1), the CAAR continues to be positive, except for the estimated value of the merged entity's CAAR, which is calculated by using the simple return approach of the market model. Competitors earn positive gains around the clearness of the examined M&As, while the merged entities loose. However, the decrease of the merged entities' security value does not offset their highly significant positive gains during the three days interval around the announcement of the merger. The positive trend of firms' residuals constitutes an indication that the market is concerned about their possibly anti competitive effects.

Investigating each M&A independently the empirical results depict that phase II merger 1 show a negative effect at the time of its clearness on firms' security value. However, it is not statistically significant.[13]

Table 3: The Vertical effects of phase - II merger 1 (%)

Method	**Merger announcement**	**All firms (competitors)**	
		AAR	**CAAR**
$R^{S}_{j,t}$	-1 +1	5,96***	4,01
$R^{S-W}_{j,t}$	-1 +1	6.02*	3.54
$R^{C}_{j,t}$	-1 +1	6.24*	3.59
	Merger notification	**AAR**	**CAAR**
$R^{S}_{j,t}$	-1 +1	0,07	0,08
$R^{S-W}_{j,t}$	-1 +1	6.02**	6.23
$R^{C}_{j,t}$	-1 +1	6.24**	6.45

Notes: See Table 2

(*) = statistical significant at $\alpha = 0{,}10$ (**) = statistical significant at $\alpha = 0{,}05$ (***) = statistical significant at $\alpha = 0{,}01$

Source: Authors' elaboration of estimated securities' data

Regarding the vertical effects of the said merger on firms' security value we conclude that the merger positively affects the competitors that are active in the various market segments both in the short and the long – run (Table 3). This result is reinforced by the fact that the AAR of all the vertical competitors (except from the estimated value of AAR with simple return approach of market model) is statistically significant with a positive sign. The positive market reaction of vertical competitors indicates that the market is concerned about the anti competitive vertical effects of the merger.[14]

The analysis of the conglomerate effects of phase – II merger 2 in Table 4 shows that the examined merger increases the efficiency of the merged entity both in the short and the long – run. This implies a cost saving efficiencies effect or pro-competitive effect, that is, lower prices and higher level of competition and consumer welfare.[15] The same result has been traced to Fotis and Polemis (2012a) in the short - run, but is not in alignment with the result derived by Rahim and Pok (2013).

We derive the same result when we analyse the horizontal effects of phase – II merger 3 during its announcement (Table 5). This result is more evident with Cohen *et al.*, (1983a) model rather than with the other models under scrutiny. In the long - run (52 calendar days from the announcement of the merger) the results are statistical significant for the total sample and particularly for the competitors under scrutiny.

The conglomerate effects of phase – II merger 4 are analysed in Table 6. The results from the relevant Table depict that the competitors gained from the clearness of the said merger. Both in the short and the long – run (68 calendar days from the announcement of the merger) the CARR is positive, especially the result obtained by the estimation of the Cohen *et al.*, (1983a) model. Therefore, the merger under examination caused anti competitive effects.

Table 4: The Conglomerate effects of phase – II merger 2 (%)

Method	Merger announcement	All firms		Competitors		Merged Firm	
		AAR	CAAR	AAR	CAAR	AR	CAR
$R^{S}_{j,t}$	-1	-0,50***	-0,50***	-0,92***	-0,92***	0,34*	0,34
	0	-0,46***	-0,95***	-0,64***	-1,56***	-0,08	0,26
	+1	-0,44***	-1,39***	-0,72***	-2,28***	0,12	0,38
	-5 +5	-0,57	-2,26*	-0,76	-3,94*	-0,18	1,11*
	-10 +10	1,68*	-0,70	2,62*	-1,43	-0,21	0,78
	-15 +15	-0,78	0,48	-1,19	-0,58	0,03	2,60*
	-20 +20	0,85	2,87	1,17	3,54	0,22	1,53
$R^{S-W}_{j,t}$	-1 +1	-0,44***	-1,80***	-0,74***	-2,94***	0,18	0,47
	-5 +5	-0,50	-4,10***	-0,72	-6,88***	-0,06	1,45***
	-10 +10	1,65*	-3,01	2,53*	-5,27	-0,09	1,52**
	-15 +15	-0,91	-1,46	-1,40	-4,12	0,07	3,86***
	-20 +20	1,23	1,17	1,69	-0,01	0,29	3,53**
$R^{C}_{j,t}$	-1 +1	-1,24***	-2,57***	-2,01***	-4,19***	0,32***	0,67***
	-5 +5	-0,52	-4,26***	-0,73	-6,88***	-0,12	0,97*
	-10 +10	1,63*	-3,32	2,53*	-5,27	-0,15	0,58
	-15 +15	-0,93	-1,93	-1,40	-4,12	0,02	2,44**
	-20 +20	1,21	0,51	1,69	-0,02	0,24	1,58
	Merger notification	**AAR**	**CAAR**	**AAR**	**CAAR**	**AR**	**CAR**
$R^{S}_{j,t}$	-1 +1	-0,05	-0,88***	-0,31	-1,77***	0,48***	0,88***
$R^{S-W}_{j,t}$	-1 +1	-0,44***	-1,80***	-0,74***	-2,94***	0,18	0,47
$R^{C}_{j,t}$	-1 +1	-1,24***	-2,57***	-2,01***	-4,19***	0,32***	0,67***
	-1 merger announcement – merger notification	**AAR**	**CAAR**	**AAR**	**CAAR**	**AR**	**CAR**
$R^{S}_{j,t}$	-1 +4	-0,40***	-1,79***	-2,31**	-3,19*	0,29*	0,66*
$R^{S-W}_{j,t}$	-1 +4	-0,87***	-2,67***	-2,31**	-3,54*	0,26*	0,73**
$R^{C}_{j,t}$	-1 +4	-0,88***	-2,72***	-2,31**	-3,54*	0,23	0,56*
	-1 merger announcement – date of merger clearness	**AAR**	**CAAR**	**AAR**	**CAAR**	**AR**	**CAR**
$R^{S}_{j,t}$	-1 +68	-0,91	-9,58	-1,54	-15,59	0,34	2,44
$R^{S-W}_{j,t}$	-1 +68	-0,75	-2,23	-1,33	-7,06	0,42	7,43***
$R^{C}_{j,t}$	-1 +68	-0,77	-3,48	-1,34	-7,14	0,37	3,85*

Notes: See Table 2
Source: Authors' elaboration of estimated securities' data

Table 5: The Horizontal effects of phase – II merger 3 (%)

Method	Event Merger announcement	All firms AAR	All firms CAAR	Competitors AAR	Competitors CAAR	Merged Firm AR	Merged Firm CAR
$R^{S}_{j,t}$	-1	1,91*	1,91	1,61*	1,61	3,74*	3,74
	0	-0,48	1,44	-0,45	1,16	-0,67	3,07
	+1	1,22	2,66*	0,85	2,02	3,43*	6,50*
	-5 +5	-0,16	-0,25	-0,20	-0,42	0,05	0,73*
	-10 +10	-0,07	-0,82*	-0,04	-1,00*	-0,25*	0,25
	-15 +15	0,06	-0,99*	0,07	-1,25**	0,01	0,60
	-20 +20	-0,17*	-1,49***	-0,20*	-1,88***	0,00	0,82
$R^{S-W}_{j,t}$	-1 +1	-0,04	0,21	-0,04	0,22	-0,04	0,16
	-5 +5	-0,27	-0,32	-0,33	-0,47	0,09	0,58*
	-10 +10	0,04	-0,65	0,08	-0,79	-0,18*	0,21
	-15 +15	0,02	-0,60	0,02	-0,78	0,04	0,47
	-20 +20	-0,17	-1,07	-0,19	-1,34	0,00	0,57
$R^{C}_{j,t}$	-1 +1	-0,08*	-0,10	-0,07*	-0,12*	-0,10	0,06
	-5 +5	0,01	-0,56***	-0,01	-0,74***	0,12	0,56*
	-10 +10	-0,09**	-1,06***	-0,08**	-1,30***	-0,13	0,36
	-15 +15	0,00	-1,41***	-0,01	-1,76***	0,07	0,64
	-20 +20	-0,08**	-1,82***	-0,10***	-2,25	0,01	0,74*
	Merger notification	**AAR**	**CAAR**	**AAR**	**CAAR**	**AR**	**CAR**
$R^{S}_{j,t}$	-1 +1	-1,21*	-1,66*	-1,09*	-1,38	-1,94***	-3,31***
$R^{S-W}_{j,t}$	-1 +1	-0,24	-0,09	-0,27	-0,11	-0,06	-0,01
$R^{C}_{j,t}$	-1 +1	-0,06	0,12	-0,06	0,12	-0,02	0,08
	-1 merger announcement – merger notification	**AAR**	**CAAR**	**AAR**	**CAAR**	**AR**	**CAR**
$R^{S}_{j,t}$	-1 +10	0,06	0,09	0,12	-0,17	-0,30	-1,61
$R^{S-W}_{j,t}$	-1 +10	0,17	-0,28	0,20	-0,39	-0,01	0,37
$R^{C}_{j,t}$	-1 +10	0,20**	-0,03	0,24**	-0,11	0,01	0,43
	-1 merger announcement – date of merger clearness	**AAR**	**CAAR**	**AAR**	**CAAR**	**AR**	**CAR**
$R^{S}_{j,t}$	-1 +52	-0,35	-1,61	-0,32	-1,83	-0,49	-0,26
$R^{S-W}_{j,t}$	-1 +52	-0,10	-2,47***	-0,13	-2,83***	0,06	-0,32
$R^{C}_{j,t}$	-1 +52	-0,04	-0,90***	-0,04	-1,09***	-0,07*	0,21

Note: See Table 2
Source: Authors' elaboration of estimated securities' data

Table 6: The Conglomerate effects phase - II merger 4 (%)

Method	Merger announcement	All firms (competitors)	
		AAR	**CAAR**
$R_{j,t}^{S}$	-1	-0,44*	-0,44
	0	-0,38	-0,82*
	+1	0,14	-0,67*
	-5 +5	-0,66	0,40
	-10 +10	1,16*	1,91
	-15 +15	-1,00*	-3,64
	-20 +20	1,05	6,89
$R_{j,t}^{S-W}$	-1 +1	0,21	0,12
	-5 +5	0,17	1,09
	-10 +10	1,10	2,51
	-15 +15	-0,91	4,61
	-20 +20	1,21	4,65
$R_{j,t}^{C}$	-1 +1	-‡	-‡
	-5 +5	-‡	-‡
	-10 +10	-‡	-‡
	-15 +15	-‡	-‡
	-20 +20	-‡	-‡
	Merger notification	**AAR**	**CAAR**
$R_{j,t}^{S}$	-1 +1	-0,09	2,39
$R_{j,t}^{S-W}$	-1 +1	0,34	2,72*
$R_{j,t}^{C}$	-1 +1	-‡	-‡
	-1 merger announcement – merger notification	**AAR**	**CAAR**
$R_{j,t}^{S}$	-1 +13	2,10*	0,62
$R_{j,t}^{S-W}$	-1 +13	2,10***	1,93*
$R_{j,t}^{C}$	-1 +13	-‡	-‡
	-1 merger announcement – date of merger clearness	**AAR**	**CAAR**
$R_{j,t}^{S}$	-1 +68	1,08	13,59***
$R_{j,t}^{S-W}$	-1 +68	1,30	3,99
$R_{j,t}^{C}$	-1 +68	-‡	-‡

Note: See Table 2
Source: Authors' elaboration of estimated securities' data

4. CONCLUSIONS

This paper applies different empirical methodologies in order to measure the security's systematic risk relating to the temporally corresponding market return. It also explores possible *anti or pro competitive effects* of four phase II M&As that took place in Greece during the period from 2006 to 2011. For this scope we apply different empirical models in a sample of firms listed in the ASE with thickly infrequent trading securities. We assess four beta evaluating models developed by Scholes and Williams (1977), Dimson (1979), Cohen et al. (1983a) and Maynes and Rumsey (1993).

The empirical results indicate that the models by Scholes and Williams (1977) and Cohen et al. (1983a) improve the biasness raised from the application of the OLS method. It is worth mentioning that, when we use the Dimson's methodology the difference between the estimated betas is not statistically significant. The applied ex post evaluation of competition policy in the whole sample depicts that competitors gain while merged entities loose (or at least do not gain) from the clearness of the scrutinized M&As in the short - run. This result indicates decreased efficiency for the merged firms and enhanced profitability for the competitors.

However, if we focus our attention on each individual phase – II M&A, the results are rather controversial. More specifically, phase – II merger 1 positively affects competitors that are active in different levels of production in the short – run (vertical anti competitive effects), while phase – II mergers 2 & 3 positively affect the level of competition in the relevant product markets both in the short and long – run (conglomerate and horizontal pro competitive effects correspondingly). Moreover, the clearness of phase – II conglomerate merger 4 decreases the level of competition in the relevant markets that affected by it.

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Notes

1. Levhari and Levy (1977) proved that the expected value of the estimated beta of aggressive stocks (beta greater than one) increases as the time interval increases and hence be over- estimated (a positive monotonicity outcome in time interval). The opposite happening for defensive stocks (Levy-Levhari hypothesis).

2. For a definition of thinly traded securities see section 2.1 below.

3. For a literature review prior to 2008 see Hong and Satchell (2014). See also Davidson and Josev (2005), Wang and Jones (2005), Ho and Tsay (2001) and Daves, Ehrhardt and Kunkel (2000).

4. For a literature review prior to 2007 see Fotis et al. (2011;74). Residual analysis has also been used in the literature in other research areas. See for instance Gleason, Pennathur and Wiggenhorn (2014), Al-Sharkas and Hassan (2010) and Jiang and Leger (2010). An application of residual analysis on antitrust and abuse of dominant position can be found, *inter alia*, in Fotis (2012). Fotis (2014) explores the unilateral effects of M&As on competition by using UPP and GUPPI analysis.

5. Phase – II M&As require an in depth investigation by the General Directorate for Competition of HCC.

6. The data are available from the authors upon request.

7. The simple returns approach calculates daily returns only for days for which stock prices are available.

8. The three – factor model (Fama and French 1993) addresses that the time variation in betas is priced, but the size and book-to-market equity effects are still statistically significant. The latter is therefore robust after taking into account the time-variation in beta. However, due to lack of data, the estimation of the three – factor model was not possible.

9. Unlike the lumped and uniform return approach which underestimate the variance of returns and bias the t-statistics used to calculate the *anti or pro completive effects* of M&As. For both approaches as well as adjusted trade-to-trade return approach see Fotis and Polemis (2012a), p 186-187.

10. Except from phase – II merger 1, where we reject H_0 derived from Cohen et al. (1983a) with two leads and lags.

11. The rationale behind the use of equation (7) in the Appendix with 4 leads and lags of market returns is that the estimated p- values of $\overline{\beta^{C,-4+4}}$ for phase – II mergers 3 and 4 are lower or at least equal than

the equivalent estimations of $\overline{\beta^{C,-3+3}}$ and $\overline{\beta^{C,-2+2}}$. Also, since the estimated beta derived from Dimson's model is inconsistent, we do not estimate equation (5) in the Appendix.

12. For the calculation of standard deviation we assume normal abnormal returns. See Maynes and Rumsey (1993).

13. We don't present the empirical results since they are not statistical significant. However, they are available from the authors upon request.

14. Even though the analysis is restricted to competitors, it is absolutely safe to assume that rivals' reaction is strong enough to make us believe that the examined merger has caused significant anti-competitive effects.

15. In this paper we don't estimate any correlation between firms' security value and consumer welfare. However, the enhancement of the latter constitutes the ultimate goal of competition policy.

Appendix

Derivation of econometric models

Following Maynes and Rumsey (1993), Fotis et al. (2011) and Fotis and Polemis (2012a) the market model forecasts that firm *j*'s security simple return at time *t* ($R^S_{j,t}$) is proportional to a market return. That is,

$$R^S_{jt} = a + \beta^S R_{m,t} + \varepsilon_{jt} \tag{1}$$

where R_{mt} is the return on the market index for the day *t* and β^s the beta coefficient of simple return market model.

Scholes and Williams (1977) have indicated that beta coefficients are downward biased for infrequently traded securities and they are upward biased for very frequently traded securities. They proposed a consistent estimator of beta which is given by equation (2):

$$\beta^{S-W} = \frac{\beta^{-1}_{jt} + \beta^{0}_{jt} + \beta^{+1}_{jt}}{(1 + 2\rho_{mt})} \tag{2}$$

where β^{-1}_{jt}, β^{0}_{jt} and β^{+1}_{jt} are estimates of beta coefficient from the regression between the observed security return and market index return at $t = -1, t = 0$ and $t = +1$ respectively and ρ_{mt} is the first-order serial correlation coefficient of market returns.

Given equations (1) and (2), the market model becomes,

$$R^{S-W}_{jt} = a + \beta^{S-W} R_{mt} + \varepsilon_{jt} \tag{3}$$

Dimson (1979) advocates that the return on a specific security depends on past, present and future returns of the market portfolio. Dimson's beta coefficient is given in equation (4):

$$\beta^{D} = \sum_{\phi=-L}^{+L} \beta_{jt+\phi} \tag{4}$$

where $\phi = -L ...... + L$ are lagged, contemporaneous and leading estimated values of beta coefficient. Substituting equation (4) into equation (1), we calculate firm *j*'s security return at time *t* (R_{jt}^{D}):

$$R_{jt}^{D} = a + \beta^{D} R_{mt} + \varepsilon_{jt} \tag{5}$$

The Cohen et al. (1983a) model (see also Cohen et al. (1983b), as opposed to the Scholes and Williams (1977) models, utilizes many leads and lags of the market portfolio's return so as to produce an efficient beta coefficient. Cohen et al. (1983a) and Fowler and Rorke (1983) argue that the beta estimator of Dimson's model generates inconsistent estimates. Cohen et al. (1983a) proposed a consistent estimator, which is given by equation (6):

$$\beta^{C} = \frac{\beta_{jt} + \sum_{\phi=1}^{L} \beta_{jt+L} + \sum_{\phi=1}^{L} \beta_{jt-L}}{(1 + \sum_{\phi=1}^{L} \rho_{mt+L} + \sum_{\phi=1}^{L} \rho_{mt-L})} \tag{6}$$

where ρ_{mt+L} and ρ_{mt-L} are the *L* – order serial correlation of market portfolio's returns and $-L, +L$ imply lagged and leading values of L. Substituting equation (6) into equation (1), we calculate firm *j*'s security return at time *t* (R_{jt}^{C}):

$$R_{jt}^{C} = a + \beta^{C} R_{mt} + \varepsilon_{jt} \tag{7}$$