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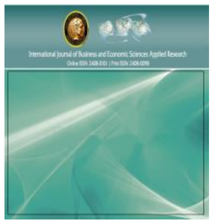

The Beta intervalling effect during a deep economic crisis- evidence from Greece

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Abstract

Purpose – *The intervalling effect bias of beta refers to the sensitivity of beta estimation with respect to the reference time interval on which returns are measured and its manifestation may indicate the degree of market inefficiencies. The purpose of this paper is to study the intervalling effect bias within an environment and during a sample period that embraces the evolution of a deep economic crisis and show in particular that its intensity is profoundly magnified.*

Design/methodology/approach – *The Athens Stock Exchange is studied via the market model during the sample period 2007-2012 that embraces the Greek debt restructuring. Two portfolios are formed to distinguish between large and small market capitalizations, three reference intervals are considered for measurement of returns (daily, weekly, monthly) and the respective betas are calculated via OLS simple regression. The results are compared to similar studies. The results are further confirmed by using a second proxy for the market portfolio.*

Findings – *The intensity of the intervalling effect bias was very pronounced during this sample period with regard to all aspects of the phenomenon that similar studies have reported and to which the results of this paper are compared.*

Originality/value – *This is the first time that the intervalling effect is examined in conjunction to a deep economic crisis environment. The intensity of the intervalling effect reflects the depth of the inefficiencies of a market for some period. As a consequence, some function measuring this intensity may be devised to serve as a measure of market inefficiencies.*

Keywords: intervalling effect; systematic risk; economic crisis; market inefficiency

JEL Classification: C10; G10; G12

1. Introduction

Under a set of rather strong assumptions, the Capital Asset Pricing Model (CAPM), introduced by (Sharpe, 1964), (Lintner, 1965) and (Black, 1972), suggests that:

$$E(R^{(i)}) = r_f + \beta_i[E(R^{(M)}) - r_f] \quad (1)$$

where $R^{(i)}$ denotes the return of asset i, r_f is the risk free rate, $R^{(M)}$ is the return of the market portfolio M, $E(.)$ denotes the expectation operator and β_i denotes the beta coefficient (or systematic risk coefficient) of asset i, with

$$\beta_i = \frac{Cov(R^{(i)}, R^{(M)})}{Var(R^{(M)})} \quad (2)$$

A standard and popular method to estimate the beta coefficients is to use the Market Model and the ordinary least squares method (OLS). Then, the beta coefficient of an asset arises as the slope parameter of a simple linear regression of the asset's return against the market portfolio's return:

$$R^{(i)} = \alpha_i + \beta_i R^{(M)} + e^{(i)} \quad (3)$$

with $\alpha^{(i)}$ being the intercept and $e^{(i)}$ the disturbance term[1].

It has to be stressed here that, despite the strong criticism and the controversy surounding CAPM, the beta coefficient has a significance of its own independently of the CAPM context. After all, the fact that the beta coefficient arises as the slope parameter of the previous simple linear regression (3), shows clearly its practical importance for an investor who tries to get an understanding of the movements of a security relative to those of the market (or to those of a reference portfolio or an index). Furthermore, equation (2) suggests that the beta of an asset represents the relative "risk" of the asset with respect to the market portfolio (the covariance), in comparison to the risk of the market (the variance). Thus, in this sense as well, the beta

[1] Looking at (1) and (3) one notices that the regression in (3) refers to gross returns and not to excess-over the risk free rate-returns. However, the difference in the estimated betas is in general very small and does not affect the study of the presence and intensity of the intervalling effect.

coefficient has its own significance, apart from its central role in the CAPM equation. Therefore, a "good" estimation of the beta coefficient and an understanding of the problems and limitations of an estimation method seem to be important independently of the various controversies of the CAPM.

It is clear that, from a theoretical point of view, the beta coefficient of a security does not depend on the length of the interval that one uses for the measurement of the rates of return. Empirical studies however, have shown that one may produce a number of significantly different estimates when performing the regression (3), due to different starting point considerations as for example the benchmark used as the market portfolio, the sample period used for observations, the length of the return measurement interval, the thinness in trading of a stock etc.

In particular, the phenomenon of the sensitivity of the beta estimation with regard to the length of the time interval that is used as the basis for the measurement of the rate of returns has been extensively studied and is known under the name of intervalling effect bias in beta estimation or simply as the intervalling effect, see for example (Hawawini, 1983), (Handa, et al., 1989), (Corhay, 1992), (Brailsford & Josev, 1997), (Pogue & Solnik, 1974), (Cohen, et al., 1983a), (Cohen, et al., 1983b), etc. Many efforts have been made to adjust the intervalling effect bias, as in (Scholes & Williams, 1977) (Dimson, 1979), (Cohen, et al., 1983a), (Cohen, et al., 1983b) etc. It should be noted here that (Ho & Tsay, 2001) provide evidence that option listing reduces the intervalling effect, supporting thus the opinion that option trading has some accelerating effect in the price-adjustment process.

Furthermore, the connection of the intervalling effect with the market capitalization of securities has been studied as well and (Hawawini, 1983) suggests that while the betas of small market capitalization tend to increase as the reference return interval is lengthened, the opposite holds for the betas of securities with large market capitalization. Further empirical work in (Handa, et al., 1989) for the NYSE and (Brailsford & Josev, 1997) for the Australian Stock Exchange came in support of Hawawini's findings. However, empirical work in (Diacogiannis & Makri, 2008) and (Milonas & Rompotis, 2013) showed that beta increases as the length of the reference time interval increases, for both small and large market value securities.

An explanation of the intervalling effect is offered in (Cohen, et al., 1983b), where they attribute this phenomenon to market frictions that result in delays of the price adjustment to the arrival of new information, which in turn induce cross serial correlations in the security returns, leading then to autocorrelation in the market portfolio returns. Moreover, it is argued in (Cohen, et al., 1983b) that these delays are related to the thin trading of various securities. In addition (Scholes & Williams, 1977) showed the existence of a downward bias in the beta estimation of thinly traded stocks while the opposite holds for heavily traded stocks.

In a somehow similar vein one may add that delays of price adjustment may also be due to slow market responses to unexpected shocks or even to overreactions in such shocks or in response to rumours, speculations, or irrational expectations (Lim, et al., 2006), something that may be expected to intensify during a financial crisis. In an efficient market, stock prices are supposed to reflect all available information, while departure from efficiency is usually assumed to be expressed in the form of linear correlations.

In any case, we are wondering whether the intensity of the intervalling effect bias could have the potential to serve as some kind of indicator of the extent of market inefficiencies. Then, one could be tempted to provide a strict definition of this intensity and devise an appropriate function of it as a measure of departure from efficiency, but such a task is beyond the scope of this study. However, the study of the intervalling effect and the provision of some preliminary evidence on its behavior and intensity with regard to different economic conditions may present some particular interest.

Within this context, we would expect a prominent manifestation of the intervalling effect in a period during which the market is in a turbulent state, as for example during a financial crisis and even more during a deep economic crisis. In this work we examine and underscore the intervalling effect bias in the Athens Stock Exchange (ASE) during the period between 3-9-2007 and 2-9-2012. This period is of particular interest since it starts 2 years before the official "announcement" of the Greek crisis (October 2009) and ecompasses the whole period of high uncertainty, that is the period extending from the end of 2010, when the restructuring of the Greek debt was first mentioned as a possible route of European policy, until March 2012, when a drastic haircut of the Greek public debt was eventually implemented. A few months later a huge recapitalization and restructuring program of the Greek banking sector was announced. Therefore, our five years sample period consists of a two years period preceding the beginning of the Greek crisis, that is a period where things seemed to be "normal", followed by a three year period of prolonged and high uncertainty. The reason for this uncertainty concerned mainly the extent and the depth of the forthcoming Greek debt restructuring rather than whether the event of restructuring would take place. We tend to believe that this was an environment favorable to the growth of all kinds of market frictions. Here we will show that during this period of deep economic crisis, the intensity of the intervalling effect was profoundly magnified when compared to the empirical findings of (Diacogiannis & Makri, 2008), who examined the intervalling effect with regard to the same market but for a different sample period (2001-2004) of "just" a financial crisis when stock prices also experienced significant fall and many securities exhibited thin trading conditions. Furthermore, the qualitative aspects of our results are compared to the corresponding results of other studies on the intervalling effect that refer to different markets. Finally, the robustness of our results will be supported by the employment of two different proxies of the market portfolio, namely the Athens Composite Index and the Eurostoxx 50 Index. With regard to the structure of the rest of the paper, in Section 2, data and methodological issues are specified, while in Section 3 the empirical results are presented together with a relevant discussion of the findings and the last section concludes.

2. Data and Methodology

2.1. The sample period and the market portfolio proxy

The sample period corresponds to the five years period extending from 3-9-2007 to 2-9-2012. Therefore, the data used in this study consists of 1248 historical daily closing prices of securities traded continuously in the ASE during this period, together with the closing prices of the Athens Composite Shares Price Index, which is a market cap weighted index and serves as a proxy for the market portfolio. These closing prices result into 1247 daily returns, 269 weekly returns and 59 monthly returns for each security during this period. In general, the period of five years that was selected is considered to be appropriate, in the sense that the beta coefficients are supposed to remain rather constant within such a period (see (Bradfield, 2003)), while on the other hand a large enough sample is available, something that is a prerequisite for an "efficient" estimation of the beta coefficient.

2.2. Capitalization & intervalling

The results in (Hawawini, 1983) suggest that when measuring betas over return measurement intervals of arbitrary length, then small market cap securities may appear to be less risky than they truly are, while the opposite happens for securities that have a relatively large market cap.

In order to examine the relation between market capitalization and intervalling effect, we chose to work with 70 securities, out of a total of 259 securities that were trading at the time. The selected securities were continuously traded during the considered period and they were chosen to cover all the sectors of the Greek economy and the whole spectrum of large, medium and small market capitalization[2]. In fact, the selected sample consists more or less of the securities that are included in the following indices: FTSE/ATHEX Large Cap, FTSE/ATHEX Med Cap and FTSE/ATHEX Small Cap.

Then, following (Brailsford & Josev, 1997), these securities were sorted according to their market capitalization and two equally weighted portfolios were formed, each consisting of 35 securities. The first of these portfolios which will be referred to as Largecap, consists of the 35 securities with the highest market capitalization as of 3-9-2012 while the second portfolio, which will be called Smallcap, consists of the remaining securities, i.e. the ones with the lowest market capitalization as of the same date. The average market capitalizations of these two portfolios amounted to 582,4 and 3,72 million euros respectively and the means were found to be significantly different since the null hypothesis regarding equality of the means was rejected at both significance levels of 5% and 1%.

2.3. Beta estimation

Each security's beta is estimated by the OLS method according to the standard market model:

$$R^{(i)}_{[t,t+\Delta t]} = \alpha^{(i)} + \beta^{(i)} R^{(M)}_{[t,t+\Delta t]} + e^{(i)}_{[t,t+\Delta t]}$$

where

$R^{(i)}_{[t,t+\Delta t]}$ and $R^{(M)}_{[t,t+\Delta t]}$ denote the return of the security i and the return of the market portfolio M respectively, during the period $[t,t+\Delta t]$, $\alpha^{(i)}, \beta^{(i)}$ are the parameters of the model and $e^{(i)}_{[t,t+\Delta t]}$ is the disturbance term. The disturbance terms are assumed to be normally distributed with zero means, homoscedastic (i.e. with constant variance), autocorrelated (i.e. $Cov(e^{(i)}_{[t-\Delta t,t]}, e^{(i)}_{[t,t+\Delta t]}) = 0$) and uncorrelated with the market returns, i.e. $Cov(R^{(M)}_{[t,t+\Delta t]}, e^{(i)}_{[t,t+\Delta t]}) = 0$.

Depending on the time interval Δt that is used (daily, weekly, monthly), a different estimation of beta is obtained. Furthermore, the beta of each of the portfolios under consideration is calculated as the average of the betas of the constituent securities.

3. Empirical Results

In this section the empirical findings are presented, with regard to the intervalling-effect bias in betas estimates when using the ordinary least squares (OLS) method. Three different intervals are used (daily, weekly and monthly) for calculating returns. The sample refers to the period between 3-9-2007 and 2-9-2012 and the number of daily, weekly and monthly returns amounted to 1247, 269 and 59 respectively. The next Table 1 presents summary statistics with regard to the beta estimation of the two portfolios under consideration for each of the three reference time intervals.

Table 1: Summary Statistics of Beta of the two Portfolios with regard to Composite ASE Index

	Largecap			Smallcap		
	Daily	**Weekly**	**Monthly**	**Daily**	**Weekly**	**Monthly**
Mean Beta	0,1345	0,7587	0,9540	0,0844	0,5272	0,6831
Stdev	0,0772	0,3116	0,3793	0,1005	0,2312	0,2895

[2] It is clear that the inclusion of only continuously traded stocks in our study may present a survivorship bias (see for example (Elton, 1996)) with a potential underestimation of the betas of the examined portfolios. However, since this study focuses on the intensity and the characteristics of the intervalling effect it is unlikely that our results will suffer from any systematic bias due to the survivorship bias.

Max Beta	0,2676	1,4045	1,9102	0,3256	0,9232	1,1527
Min Beta	-0,0418	0,0935	0,1534	-0,0983	0,0047	0,1501
Range	0,3094	1,3110	1,7568	0,4239	0,9186	1,0025
Skewness	-0,8446	0,1325	0,4809	0,3355	-0,1038	-0,1844
Kurtosis	0,0840	-0,2281	0,4969	-0,4300	-0,6139	-1,0867
Std error B	0,0418	0,0982	0,1589	0,0598	0,1186	0,3945
Mean R^2	0,0110	0,2435	0,4474	0,0046	0,0891	0,1789

3.1. Increase of beta estimation with interval length

First of all it can be noticed from Table 1 above, that the lengthening of the returns measurement interval leads to an increase of the estimated beta, both for the Largecap and the Smallcap portfolios. With regard to the Smallcap portfolio this is in accordance to results of previous relevant studies, i.e. that the estimation of the beta of small caps increases as the corresponding returns measurement interval increases. On the other hand though, the fact that the beta of the Largecap portfolio increases as well together with the lengthening of the returns measurement interval, comes in contrast to (Brailsford & Josev, 1997) where it was reported that for the Australian Stock Exchange the betas of the highly capitalized firms were decreasing as the return measurement interval was increasing. However our result is in accordance to (Diacogiannis & Makri, 2008) where a comparable study was performed for the Athens Stock Exchange for a four years period extending between 2001 and 2004. This may indicate either some particularity of the Greek Stock exchange when compared for example to the Australian stock exchange or even a phenomenon that appears when the sample period involves an extended subperiod of falling prices.

3.2. Rate of increase of beta

It is remarkable that the increase in beta as the time interval increases is rather dramatic when we move from the daily to the weekly interval, while this is not as profound (although still very large) when we move from the weekly to the monthly interval. Even more remarkable though, is the rate of this increase when compared to analogous results in (Diacogiannis & Makri, 2008). More precisely, when moving from daily to monthly returns, the Largecap portolio that we examined exhibits a 609% increase in beta, while the corresponding increase in (Diacogiannis & Makri, 2008) is only 13%. Similarly, for the Smallcap portfolio the respective numbers amount to 709% vs 23%.

3.3. Range of beta

With regard to the range of beta, i.e. the difference between the minimum and the maximum betas in the portfolios, we notice that the range increases as the reference time interval increases and the maximum range is observed at the Largecap portfolio. This is in contrast to the results of both (Brailsford & Josev, 1997) and (Diacogiannis & Makri, 2008) who observed the largest range at their respective small capitalization portfolios. Again, comparing these results to those of (Diacogiannis & Makri, 2008) we notice that when moving from daily to monthly returns, the range of beta corresponding to the Largecap portfolio shows an increase of 468% while the corresponding increase in (Diacogiannis & Makri, 2008) is just 47%. Similarly, for the Smallcap portfolio the respective numbers amount to 142% vs 55%.

3.4. Standard deviation

Furthermore the standard deviation of beta increases as the reference time interval increases. This seems to be a natural consequence of the fact that the number of observations used at the OLS regression is decreasing as the reference time interval increases (1247 daily observations, 269 weekly observations, 59 monthly observations). A similar remark was also made in (Handa, et al., 1989).

3.5. Testing for equality of mean betas

In Table 2, it is shown that the zero hypothesis of equality of the mean betas is rejected at the significance level 5% for both portfolios and for any pair of reference time intervals. Therefore the intervalling effect is present and it can be said that the estimation of systemic risk, as this is represented by beta, changes significantly as the returns measurement interval changes.

Table 2: t-test for Equality of Mean Betas per Two Series and per Portfolio

	Largecap			*Smallcap*		
	Daily	**Weekly**	**Monthly**	**Daily**	**Weekly**	**Monthly**
Daily						
t-test		-11,503	-12,524		-10,394	-11,557
p-value		0,000	0,000		0,000	0,000
Mean difference		-0,6241	-0,8194		-0,4428	-0,5986
Std. error difference		0,0543	0,0654		0,0426	0,0518
Weekly						
t-test	-11,503		-2,354	-10,394		-2,489
p-value	0,000		0,022	0,000		0,015
Mean difference	-0,6241		-0,1953	-0,4428		-0,1558
Std. error difference	0,0543		0,0830	0,0426		0,0626

Monthly						
t-test	-12,524	-2,354		-11,557	-2,489	
p-value	0,000	0,022		0,000	0,015	
Mean difference	-0,8194	-0,1953		-0,5986	-0,1558	
Std. error difference	0,0654	0,0830		0,0518	0,0626	

3.6. The coefficient R^2

The R^2 coefficient measures the degree to which the securities returns are explained by the Index returns. In Table 3 one can see the mean values of R^2 for the two portfolios and for the various returns measurement intervals. It can be noticed that R^2 increases as the reference time interval is lengthened and that this coefficient takes clearly larger values for the Largecap portfolio. This comes in accordance to the results of (Dimson, 1979), (Cohen, et al., 1983a), (Brailsford & Josev, 1997) and (Diacogiannis & Makri, 2008). This result indicates that by lengthening the returns measurement interval the explanatory effect of the Index gets stronger. Notice however that for the Largecap portfolio, the Index explains only the 1,1% of the variation of the returns when the daily interval is used while this explanatory power increases significantly to 23,35% and even further to 44,74% when the weekly or the monthly interval respectively are used. It should be remarked that the majority of the securities that participate in the Largecap portfolio, participate also in the composition of the Index and therefore it is natural to expect a strong correlation between the returns of the Largecap portfolio and the returns of the Index. On the contrary, the returns of the Smallcap portfolio are explained very poorly by the returns of the Index, at any time interval, reaching a maximum R^2 of 17,88% when the monthly interval is used. Table 3 shows a comparison of these findings (period 2007-2012) to those of (Diacogiannis & Makri, 2008) (period 2001-2004). One can notice a remarkable deterioration of the explanatory power of the Index especially on the daily basis.

Table 3: R^2 for two different periods

R^2	Daily	Monthly
Largecap (2001-2004)	0,428	0,526
Largecap (2007-2012)	0,011	0,447
Smallcap (2001-2004)	0,186	0,363
Smallcap (2007-2012)	0,005	0,179

3.7. Testing for equality of R^2s

Finally, one can see from Table 4 that the zero hypothesis of equality of the mean R^2s is rejected at the significance level 5% for both portfolios and for any pair of reference time interval, supporting even further the presence of the intervalling effect.

Table 4: t-test for R^2 Equality per Two Series and per Portfolio

	Largecap			*Smallcap*		
	Daily	**Weekly**	**Monthly**	**Daily**	**Weekly**	**Monthly**
Daily						
t-test		-15,548	-21,049		-5,960	-8,272
p-value		0,000	0,000		0,000	0,000
Mean difference		-0,2324	-0,4364		-0,0844	-0,1743
Std. error difference		0,0149	0,0207		0,0141	0,0211
Weekly						
t-test	-15,548		-8,004	-5,960		-3,551
p-value	0,000		0,000	0,000		0,001
Mean difference	-0,2324		-0,2040	-0,0844		-0,0899
Std. error difference	0,0149		0,0255	0,0141		0,0253
Monthly						
t-test	-21,049	-8,004		-8,272	-3,551	
p-value	0,000	0,000		0,000	0,001	
Mean difference	-0,4364	-0,2040		-0,1743	-0,0899	
Std. error difference	0,0207	0,0255		0,0211	0,0253	

3.8. Regressing with regard to another market proxy

Due to Roll's critique (Roll, 1977) one may argue that the previous results come as a mere consequence of the fact that the ASE Composite Index that was chosen as a proxy to represent the market portfolio, is not mean-variance efficient. In order to temper such an objection and to further support the robustness of our results we have performed the same analysis but using another index as the proxy for the market portfolio, namely the EuroStoxx 50 index. It turned out that the results obtained, with the role of the market being played by the Eurostoxx 50 Index instead of the ASE Composite Index, are in full accordance to the results presented and discussed in the previous subsections. The next Table 5 presents the relevant results that can be compared to the corresponding ones of Table 1. Furthermore, equality of mean betas and equality of equality of means and for equality of R^2 s were also tested and rejected at the 5% significance level for both portfolios and for any pair of reference intervals.

Table 5: Summary Statistics of Beta of the two Portfolios with regard to EUROSTOXX 50 index

	Largecap			Smallcap		
	Daily	**Weekly**	**Monthly**	**Daily**	**Weekly**	**Monthly**
Mean Beta	0,5718	0,8554	1,1427	0,2282	0,6088	0,9068
Stdev	0,3085	0,3422	0,4501	0,1918	0,2447	0,3744
Max Beta	1,1612	1,5686	2,0966	0,6367	1,0373	1,4509
Min Beta	0,0141	0,0596	0,1927	-0,0346	0,0382	0,1026
Range	1,1472	1,5091	1,9039	0,6714	0,9990	1,3483
Skewness	-0,1646	-0,0320	0,2009	0,3960	-0,5229	-0,3761
Kurtosis	-0,9570	-0,2406	-0,2461	-0,9708	-0,1971	-0,7911
Std error B	0,0666	0,1081	0,2137	0,0720	0,1565	0,3010
Mean R^2	0,1088	0,1872	0,3241	0,0165	0,0640	0,1607

3.9. Firms with stock options listings

As it was stated in the introduction,(Ho & Tsay, 2001)have provided evidence that option listing reduces the intervalling effect, supporting thus the opinion that option trading has some accelerating effect in the price-adjustment process. In this subsection we will briefly examine the intervalling effect with regard to an equally weighted "optioned" portfolio, consisting of the six largest companies of the Athens Stock Exchange that have listed stock options. The next two Tables 6 and 7 present the beta statistics of this Optioned portfolio in comparison to the Largecap portfolio and with regard to both market proxies, the ASE and the EUROSTOXX 50 indices. It can be readily seen in both cases that apart from some small improvement in the explanatory power of the proxies in the weekly and monthly cases, the evolution of the mean beta as we pass from the daily to the weekly to the monthly data has not shown any improvement at all. Therefore, the intervalling effect was still intense even in this case, allowing us to conjecture that whatever improvement one would expect in the price-adjustment process was rather overshadowed by the effect of the evolving economic crisis.

Table 6: Summary Statistics of Beta of the Largecap vs the Optioned Portfolio, with regard to Composite ASE Index

	Largecap			Optioned		
	Daily	**Weekly**	**Monthly**	**Daily**	**Weekly**	**Monthly**
Mean Beta	0,1345	0,7587	0,9540	0,1572	0,9992	1,2871
Stdev	0,0772	0,3116	0,3793	0,0313	0,2984	0,3606
Max Beta	0,2676	1,4045	1,9102	0,1819	1,3119	1,7472
Min Beta	-0,0418	0,0935	0,1534	0,1093	0,6184	0,8823
Range	0,3094	1,3110	1,7568	0,0726	0,6934	0,8649
Skewness	-0,8446	0,1325	0,4809	-1,0525	-0,0902	0,2006
Kurtosis	0,0840	-0,2281	0,4969	-1,1739	-2,4171	-2,3486
Std error B	0,0418	0,0982	0,1589	0,0507	0,0945	0,1641
Mean R^2	0,0110	0,2435	0,4474	0,0079	0,2927	0,5206

Table 7: Summary Statistics of Beta of the Largecap vs the Optioned Portfolio, with regard to EUROSTOXX 50 Index

	Largecap			Optioned		
	Daily	**Weekly**	**Monthly**	**Daily**	**Weekly**	**Monthly**
Mean Beta	0,5718	0,8554	1,1427	0,8124	1,0824	1,4781
Stdev	0,3085	0,3422	0,4501	0,2557	0,3606	0,4455
Max Beta	1,1612	1,5686	2,0966	1,1612	1,5686	1,9957
Min Beta	0,0141	0,0596	0,1927	0,4778	0,5803	0,8363
Range	1,1472	1,5091	1,9039	0,6834	0,9883	1,1594
Skewness	-0,1646	-0,0320	0,2009	0,0783	-0,0832	-0,3380
Kurtosis	-0,9570	-0,2406	-0,2461	-1,3810	-0,9000	-1,4934
Std error B	0,0666	0,1081	0,2137	0,0571	0,1299	0,2732
Mean R^2	0,1088	0,1872	0,3241	0,1383	0,2033	0,3341

4. Conclusion

A deep economic crisis period designates a time of possible future changes of the economy. During this period of change, the market may exhibit an increasing degree of inefficiency as for example the price adjustment delays that have been reported as an explanation of the intervalling effect bias in beta estimation. In this work the intervalling effect bias in OLS beta estimation is empirically examined within the context of a market that is under the impact of the evolution of a deep economic crisis. The market examined is the Athens Stock Exchange during a five years sample period ranging from 3-9-2007 to 2-9-2012. It is found that the intensity of the intervalling effect bias was very pronounced during this sample period with regard to all aspects of the phenomenon that similar studies have reported and to which the results of this paper were compared.

One final speculative remark could be that if the market model is correct then it seems that the intensity of the intervalling effect reflects the depth of the inefficiencies of a market for some period. If this is true, then some function reflecting this intensity may be devised to serve as a measure of market inefficiencies.

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