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THE INTERVAL EFFECT IN ESTIMATING BETA: EMPIRICAL EVIDENCE FROM THE ROMANIAN STOCK MARKET

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Abstract. This study presents empirical evidence regarding the interval effect in estimation of beta coefficients for stocks listed on the Bucharest Stock Exchange. Employing the standard market model, this paper finds that beta estimates for the same stock differs considerably when daily and monthly returns are used. Further, using a linear regression model, this paper shows that the differences between monthly and daily beta estimates are negatively related to some characteristics of stock, like market capitalization and trading intensity.

1. INTRODUCTION

The volatility or beta coefficient is an important indicator which assesses the security's exposure to systematic risk. In these circumstances a correct estimation of beta coefficient is fundamental in many areas of finance. On the one hand, practitioners can use the beta coefficient to estimate the cost of equity, to apply different valuation models and to assess the performance of a security portfolio. On the other hand, the beta is used by researchers to test different models of expected return which include market risk as one of the risk factors (e.g. the Capital Asset Pricing Model - CAPM) and to perform event studies.

According to different criteria, like the market index used as a proxy of market portfolio, the length of the estimation period and the length of the return interval,[1] using the standard market model, a set of beta estimates can be obtained for each stock. Despite the existence of a large financial literature which discusses the estimation of beta coefficient, there is no consensus how the best estimate could be obtained. Moreover, there is no consensus with respect to the market index, time frame or the length of the return interval that should be used for estimation.[2]

The present study has two goals. The first purpose is to test the sensitivity of beta coefficient to the length of the return interval, known as the interval effect (Armitage and Brzeszczynski, 2011) or intervaling effect (Corhay, 1992). Because little evidence is provided on this issue outside the developed markets, it is interesting to assess if the interval effect is present across

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This paper is in final form and no version of it will be submitted for publication elsewhere.

[1]The return interval represents the interval over which the stock returns are measured.

[2]Bartholdy and Peare (2005) found that 5 years of monthly data and an equal-weighted index, as opposed to the commonly recommended value weighted index, provide the best estimate for beta coefficient and implementation of the CAPM or Fama and French three factor model in estimating the cost of equity. Another study which was conducted also in the universe of U.S. capital markets, Daves et al.(2000) concluded that the financial managers should use daily stock returns to estimate beta coefficient since they produce a smaller standard error for the estimates than the weekly, bi-weekly and monthly stock returns. Also they reported that a period of three years is the best choice for the length of estimation period.

international markets, especially in the case of frontier markets like the Romanian one. Furthermore, to the author's knowledge, a similar analysis has not been realized yet for the Romanian stock market. The second purpose is to investigate the relationship between some characteristics of stocks and the magnitude of the interval effect in beta estimates.

This paper shows that in general the monthly beta estimates are higher than the daily beta estimates for most of the stocks listed on the Romanian stock market. This finding confirms the observation from the developed stock markets and validates the hypothesis that friction in the trading process delays the adjustment of a security's price to informational change and hence leads to an interval effect (Cohen et al., 1983). Furthermore, investigating the difference between betas calculated from monthly returns and daily returns, it appears that the difference is larger for the stocks of companies with relatively small market capitalization and for less traded stocks.

The remainder of the paper is structured as follows. In Section 2, the related literature is presented. Section 3 describes the methodology and database. Section 4 presents the main results and Section 5 concludes.

2. LITERATURE REVIEW

An important issue that has been addressed in many studies is the sensitivity of beta coefficient to the length of the return interval. Some of the first empirical results are provided by Pogue and Solnik (1974). They observed that the mean of beta coefficients, estimated on monthly returns, is higher than the one obtained on the daily returns. Another interesting effect is given by the impact of the return interval on the estimates of determination coefficients from the market model. In this regard, Pogue and Solnik (1974) concluded that the mean of determination coefficients rise with the increase of the return interval.

In a comprehensive analysis, Cohen at al. (1980) reviewed the market microstructure evidence and concluded that the sensitivity of beta estimates to changes in the return interval exists. More specifically, the betas of thinly (infrequently) traded stocks increase and the betas of frequently traded stocks decrease when the return interval is lengthened. Moreover, there is generally an increase of the determination coefficient when the return interval is lengthened, in this case for both types of stocks, the largest increase been achieved for thinly traded stocks.

Hawawini (1983) noted that the betas of securities with smaller market capitalization than the average of the all security outstanding will increase as the return interval is lengthened and the betas of securities with large market capitalization will decrease. In this context, Hawawini (1983) suggested that the securities with relatively small market capitalization may appear to be less risky than they truly are and the securities with relatively large market capitalization may appear to be more risky than they truly are. As such, Handa et al. (1989) showed that the presence of the interval effect has implications for testing the size effect.[3] Handa et al. (1989) reported that the betas of companies with small market capitalization rise and the betas of companies with big market capitalization fall as the return interval is lengthened from daily to monthly to annuals intervals. Furthermore, Handa et al. (1989) concluded that the size effect disappears when betas are estimated on annual returns. Also, the length of the return interval proved to have an impact in testing the CAPM. In this regard, Handa et al. (1993) rejected the CAPM when monthly returns are used and failed to reject the model when annual returns are employed in the test procedure.

In a subsequent study, Corhay (1992) examined the existence of the interval effect in the case of Brussels Stock Exchange for three periods. For each period, ten portfolios were built based on the market capitalization of companies from the sample and different lengths for the return interval were used. The study identified the existence of the interval effect, but generally, for

[3]Some studies claim that investments in small companies (companies with small market capitalization) provide higher risk-adjusted returns compared to those in big companies (Banz, 1981; Fama and French, 1992). A recent survey of the size effect is provided in van Dijk (2011) and includes U.S. and some international evidences.

all firms and portfolios, the betas rise as the return interval is lengthened from daily to thirty days.

Evidences regarding the length of the return interval, that impact on beta estimates, also arise from the study of Brailsford and Josev (1997), for the case of Australian stock market. For the period January 1988-December 1992, they built a portfolio of stocks with the lowest capitalization and one of stocks with the highest capitalization. The paper found that the mean of beta estimates of low capitalization stocks rises and the mean of beta estimates of high capitalization stocks falls when the return interval is lengthened from daily to weekly to monthly intervals. Also, the mean of determination coefficients increases as the return interval is lengthened for the two groups of stocks.

Using a similar methodology to that of Brailsford and Josev (1997), Diacogiannis and Makri (2008) reached similar conclusions about the presence of the interval effect on the Greek stock market. Compared to previous studies (Brailsford and Josev, 1997; Handa et al., 1989), this paper found that the mean of beta estimates of low capitalization stocks and also of high capitalization stocks increases as the return interval is lengthened from daily to biweekly to monthly intervals. The result of Diacogiannis and Makri (2008) is sustained by Milionis (2011) who noted that the beta estimates are sensitive with respect to the return interval changes. The mean of beta estimates of Greek stocks increases as the return interval is lengthened from daily to thirty days intervals. Brzeszczyñski et al. (2011) examined the interval effect in beta estimation for the Polish stock market. They observed that beta estimates for the same stock differ considerably when various intervals are used.

Some papers attempted to provide explanations to the changes in beta estimates when the return interval is lengthened. According to Hawawini (1983), the responsible factor for a shift in beta estimates is the existence of intertemporal (non-contemporaneous) relationship between daily return of securities and those of general market. Cohen et al. (1980) assigned much of the above phenomena to friction in the trading process, which causes delays in response of a security's price to informational change. Because of the existence of price adjustment delay factors, the full impact of new information, emerged in the market, is not always reflected into security prices. Therefore, beta estimates based on small return intervals will be biased. However, when the return interval is lengthened, the impact of market frictions is reduced and prices integrate much of the information. As such, less bias is introduced when beta is estimated using longer return intervals. Cohen et al. (1980) suggested that the greater (less) is the delay of the security's price relative to the weighted average delayed in the market, the more will be downward (upward) biased the beta estimate compared with the true beta, when a smaller return interval is used in estimation (e.g. daily returns).In another study, Handa et al. (1989) suggested that the sensitivity of beta estimates with respect to the return interval is caused by the fact that the covariance between the asset and the market and the variance of the market do not change proportionately as the return interval is changed.

3. METHODOLOGY AND DATABASE

3.1. **METHODOLOGY.** The first objective of this study is to identify and examine the differences in beta estimates obtained using returns constructed over various intervals. For this purpose, the standard market model is estimated through Ordinary Least Squares method (OLS):

$$R_{it} = \alpha_i + \beta_i \cdot R_{Mt} + \varepsilon_{it} \tag{3.1}$$

where:R_{it} is the return of stock i over the return interval t; R_{Mt} is the return of market portfolio over the return interval t; α_i is the intercept of stock i; β_i is the volatility or beta coefficient of stock i measured as $cov(R_{it}, R_{Mt})/var(R_{Mt})$; t is the interval length for construction of stock and market portfolio return; ε_{it} is the error term for stock i over the return interval t

which is assumed to be independent and identically distributed with zero mean and constant variance.[4]

In order to investigate the sensitivity of β_i with respect to the return interval changes, the equation of standard market model is estimated for two different intervals: 1 and 21 trading days (corresponding to 1 day and 1 month respectively).The interval effect is examined in two periods. The first period is between January 2002-December 2006 and the second between January 2007-December 2011.This paper uses periods of five years because Bartholdy and Peare (2005) and Armitage and Brzeszczyński (2011) suggested that this is the appropriate length of the estimation period.

The second objective of this paper is to identify the factors that influence the differences in beta estimates. For this purpose, the cross-section analysis is employed where the dependent variable is the difference between monthly and daily beta previously estimated. The explicative variables are stocks' characteristics, like their market capitalization and trading intensity. Hawawini (1983) suggested that the market capitalization is a good proxy for the intensity of trading. Brailsford and Josev (1997) found evidence in support of this assumption.[5] For the trading intensity, this paper used such proxies like: trade frequency, trading volume and number of trades. In this analysis, the study uses only the stocks for which both the daily and monthly beta estimates are statistically significant (Brzeszczyński et al., 2011). Therefore, the samples for the two periods are not the same.

3.2. **DATABASE.** The database is composed of daily closing prices for all stocks listed in the first, second and third section of the Bucharest Stock Exchange (BSE) from January 2002 to December 2011. Thus, the sample includes 41 stocks listed on the BSE. The source of the price series is the website of KTD Invest SA - www.ktd.ro. Since the price series have registered days in which the stocks were not traded, attributing the previous day's price for the non-trading day is chosen as a method of adjustment (Bartholdy, Olson and Peare, 2007). The current work choses the Bucharest Exchange Trading-Composite index (BET-C) to represent the market portfolio.[6] The source for the daily closing levels of BET-C index is the website of BSE – www.bvb.ro.

The daily and monthly returns of stock and market index are computed as continuous compounded return, using daily closing prices. The stock prices are not adjusted for capital changes because the current work did not find reliable information. This can be a major problem when we estimate the equations of standard market model because of the presence of extreme observations (outliers) in the series of stock returns that lead to distortions of the econometric results (Brooks, 2008). To this end, the outliers are treated by winsorising the series of returns at 3 standard deviations (Novak and Petr, 2010).[7]

For the second objective of this study, the market capitalization (CAP) of every stock is computed as the mean daily market capitalization for each distinct period. The trading frequency (FREQ) is calculated as the ratio between the number of days in which a stock was traded and the total number of possible days of trading for every analyzed period.

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[4]Nevertheless, the error terms could be autocorrelated and the error variance time dependent. Armitage and Brzeszczyński (2011) reported that the estimates of beta from OLS adjusted for autocorrelation are very similar to the standard OLS betas. Furthermore, they reported that the mean beta estimates are slightly higher by using the OLS than the ARCH models. In conclusion, the adjustment for autocorrelation and heteroscedasticity do not make much difference in estimating the beta coefficient compared with the standard OLS method.

[5]A test for the assumption that market capitalization is a good proxy for the intensity of trading is provided in the next section.

[6]BET-C was launched in 16 April 1998 and calculated until 22 June 2014. In 23 June 2014 the BET-C index was replaced by the Bucharest Exchange Trading Plus Index (BET Plus).BET-C was the composite index of the Bucharest Stock Exchange. It was a weighted market capitalization index and reflected the price movement of all companies listed on the BSE regulated market, on Ist and on IInd categories, with the exception of the Romanian closed end funds resulting in the privatization process.

[7]Note that the procedure was repeated for both daily and monthly series of stock returns.

Table I: Descriptive statistics

BSE code	FREQ	CAP (million RON)	VOL (number of stocks)	TRANS (number of trades)	FREQ	CAP (million RON)	VOL (number of stocks)	TRANS (number of trades)
	2002 - 2006				2007 - 2011			
ALR	79.13%	1316.25	34878	7.98	89.76%	3136.81	18883	22.5
AMO	90.94%	44.28	2475566	80.06	94.60%	37.33	3748888	110.43
APC	85.68%	23.69	22813	6.83	63.89%	51.96	13773	3.8
ARM	70.47%	9.77	14013	3.89	58.33%	9.65	17279	3.9
ARS	77.27%	41.59	1378	3.09	80.87%	123.62	9803	7.68
ART	76.78%	37.49	2128	4.76	83.10%	274.59	3357	10.24
ATB	96.28%	251.52	240544	54.86	97.62%	425.87	189667	62.42
AZO	93.53%	121.36	306176	31.11	97.78%	217.92	658725	102.2
BRD	91.50%	5469.73	224467	86.75	99.21%	10674.37	237696	219.21
BRM	78.72%	22.57	7597	4.6	82.70%	23.21	13014	10.5
CBC	52.99%	14.3	789	2.06	50.40%	31.92	3236	2.64
CMF	64.48%	20.1	1641	2.56	44.29%	79.9	1948	4.17
CMP	93.04%	71.61	110563	23.3	96.59%	138.13	143107	32.62
COS	18.37%	40.06	208	0.36	48.49%	241.67	590	2.03
ELJ	53.88%	41.65	41347	4.78	38.89%	19.61	10392	2.85
ENP	28.80%	3.01	562	1.18	38.25%	4.83	592	2.04
EPT	91.99%	22.37	74247	18.87	81.51%	55.87	42070	15.47
IMP	91.18%	228.92	564989	56.84	85.48%	309.79	990814	67.99
MEF	58.66%	11.2	1092	2.42	29.21%	7	435	0.77
MJM	56.15%	35.09	3452	3.55	4.52%	28.57	40	0.08
MPN	25.49%	47.34	11691	0.93	62.54%	147.72	334614	5.41
OIL	89.16%	94.73	173211	23.3	94.37%	209.55	150056	28.65
OLT	86.97%	453.56	342530	39.42	95.56%	579.56	338097	66.25
PEI	92.15%	35.87	59	10.76	78.02%	17.66	63	7.49
PPL	58.74%	15.62	10797	6.06	56.35%	86.53	27715	8.25
PTR	93.61%	15.87	128195	16.56	92.94%	118.74	195056	44.64
SCD	94.66%	284.35	151463	55.59	96.51%	379.66	234636	29.74
SIF1	97.09%	568.77	900920	334.04	98.97%	916.78	1076446	308.36
SIF2	97.25%	484.56	1555304	403.38	98.73%	853.07	2072444	426.68
SIF3	96.76%	558.14	944809	337.06	98.97%	1021.44	2286416	434.48
SIF4	96.28%	580.16	759288	318.2	98.89%	888.19	1373333	333.44
SIF5	96.76%	621.83	1605280	402.22	98.65%	1128.36	2590581	520.62
SNO	66.42%	37.7	4089	3.37	78.97%	71.95	5486	7.57
SNP	91.67%	14537.96	5699731	404.4	98.81%	20608.79	4915116	237.78
SRT	77.27%	11.39	295309	32.42	72.22%	6.73	166051	11.89
STZ	90.21%	12.57	139271	16.7	51.11%	25.99	31215	4.42
TBM	83.25%	134.58	71839	15.17	97.38%	94.06	332767	43.25
TLV	95.15%	1241.31	2172245	205.26	91.75%	2512.55	2450711	254.95
UAM	77.35%	9.55	9295	7.15	52.54%	16.06	12548	4.98
UCM	5.02%	19.77	27	0.08	13.65%	32.9	1330	0.35
ZIM	68.12%	8.16	3560	3.9	41.27%	10.3	5052	2.02

Notes: FREQ is calculated as the ratio between the number of days in which a stock was traded and the total number of possible days of trading for each analyzed period. CAP is computed as the mean daily market capitalization. VOL is calculated as the mean daily trading volume. TRANS is computed as the mean daily number of trades.

The trading volume (VOL) is computed as the mean daily trading volume and the number of trades (TRANS) as the mean daily number of trades for the two periods. The source of this data is the website of BSE – www.bvb.ro and the website of KTD Invest SA - www.ktd.ro. Moreover, the Table I lists the BSE code of each company in the sample and their characteristics.

The relationship between trading frequency and market capitalization is positive. This evidence is provided by the correlation between the logarithmic market capitalization and the measure of trading frequency. The correlation coefficient between these two series is 0.50 (p-value<0.01) for the first period and 0.67 (p-value<0.01) for the second period. These results are consistent with the view that market capitalization is a good proxy for the intensity of trading. More evidences are provided by the correlation between the logarithmic market capitalization and the logarithmic trading volume and the logarithmic number of trades. For the two periods all of this correlation coefficients are positive and bigger than 0.6 (p-value<0.01). In conclusion, in the Romanian case, frequently traded stocks have big market capitalization, high trading volume and a high number of transactions. This finding is similar to that of Brailsford and Josev (1997).

4. RESULTS

In the first part of this section, the current work provides and discusses the estimates of beta and determination coefficient. Further, Table II reports the estimated coefficients for the two periods considered by this paper.

For the first period, January 2002-December 2006, in general, the monthly beta estimates are higher than the daily beta estimates. This result suggests that for most of the stocks, the daily beta estimates suffer by a downward bias cause by friction in the trading process which delays the response of stock prices to informational change. The mean (median) difference is 0.1549 (0.1590) with a range between -0.4645 and 0.7337. The mean (median) beta increases from 0.5290 (0.5374) using daily returns to 0.6839 (0.7512) using monthly returns. In percentage terms, the mean (median) beta increases with 29% (40%).

For three stocks (BRD, CMP and SNP), the daily beta is bigger than the monthly beta. This fact is normal because these stocks are intensively traded, as their measure of trading frequency is above 90%. Moreover, BRD and SNP have the largest average market capitalizations in the sample. The results show that for some stocks (ARS, CMF, COS and ELJ) the daily beta is statistically significant, but the monthly beta is insignificant.[8] Also, for one stock (MJM), the daily beta is statistically insignificant, but the monthly beta is significant. This evidence is in accordance with the theory. Increasing the return interval from daily to monthly, the impact of the price adjustment delay factors is diminish, the stock price reflecting more information and as a consequence the monthly beta estimate being less downward biased. For three stocks (ENP, PPL and UCM) both daily and monthly betas are not statistically significant. This is an interesting result because the length of the estimation period is recommended to be no more than five years (Bartholdy and Peare, 2005; Armitage and Brzeszczyński, 2011). However, this recommendation may not be appropriate for stocks characterized by very low liquidity.

For the second period, the results of beta estimates are similar. The estimates of monthly betas are in general higher than those from daily data with a few exceptions. The mean (median) difference is 0.1804 (0.1346) with a range between -0.3238 and 0.5933.The mean (median) beta increases from 0.6554 (0.5875) using daily returns to 0.8381 (0.8887) using monthly returns. In percentage terms, the mean (median) beta increases with 28% (51%). Also, some stocks have statistically significant daily beta with insignificant monthly beta. Finally, some of them have only significant monthly beta and others do not have daily or monthly significant betas.

[8] A discussion of the relationship between price-adjustment delays and the market capitalization can be found in Cohen et al. (1980).

Table II: OLS beta estimates and R-squared (a)								
BSE code	Daily beta	Monthly beta	Daily R-suqred	Monthly R-squared	Daily beta	Monthly beta	Daily R-squared	Monthly R-squared
	2002-2006				2007-2011			
ALR	0.6415*	0.7146*	7.86%	22.33%	0.9116*	1.0256*	34.00%	43.97%
AMO	0.6743*	0.9503*	6.06%	18.60%	1.1093*	1.0462*	23.31%	31.06%
APC	0.5013*	0.8415*	3.51%	29.35%	0.4121*	0.5847*	4.41%	18.91%
ARM	0.5374*	0.8375*	3.84%	28.65%	0.3643*	0.7729*	2.49%	30.89%
ARS	0.1989*	0.1280	0.71%	0.00%	0.5868*	0.8887*	10.31%	24.96%
ART	0.6038*	0.7279*	4.53%	12.08%	0.8012*	1.1015*	17.34%	35.42%
ATB	0.0815*	0.8152*	0.24%	33.54%	0.0296	0.5068*	0.00%	22.29%
AZO	0.8081*	1.1279*	12.62%	29.32%	0.9551*	1.0358*	23.15%	26.64%
BRD	1.1277*	1.0257*	44.49%	30.82%	1.1629*	1.2441*	71.06%	79.74%
BRM	0.2290*	0.7512*	1.08%	17.67%	0.5498*	0.9339*	10.41%	31.68%
CBC	0.1241***	0.5558*	0.30%	7.49%	0.2589*	0.7136*	1.54%	19.09%
CMF	0.1506**	0.3138	0.46%	0.00%	0.2160*	0.1585	1.48%	0.00%
CMP	0.7787*	0.5500*	12.72%	11.10%	1.0596*	1.4853*	35.06%	58.28%
COS	0.1486**	0.3495	0.50%	0.00%	0.4571*	0.9217*	4.75%	30.10%
ELJ	0.3363*	0.1887	3.55%	0.00%	0.1915*	0.206	1.28%	0.00%
ENP	0.0195	0.1496	0.00%	0.00%	0.2063*	0.7119*	1.19%	15.85%
EPT	0.5941*	0.8132*	3.50%	25.31%	0.9169*	1.3193*	11.08%	38.65%
IMP	0.6930*	1.2470*	10.38%	40.47%	1.1685*	1.3259*	32.01%	25.10%
MEF	0.3807*	0.5721*	2.26%	14.50%	0.2202*	0.5895*	1.60%	18.33%
MJM	0.0877	-0.4645**	0.00%	6.17%	0.0322	0.3482***	0.00%	5.23%
MPN	0.2394*	0.7293*	0.80%	10.84%	0.3238*	0.1402	2.92%	0.00%
OIL	0.7202*	0.9028*	10.95%	37.76%	0.8064*	1.1796*	19.83%	47.58%
OLT	0.8104*	0.916*	9.23%	15.05%	1.0497*	1.5587*	18.13%	34.82%
PEI	0.4053*	0.5608*	2.71%	10.10%	0.5419*	0.6764*	7.13%	25.42%
PPL	0.0931	0.1353	0.00%	0.00%	0.2910*	0.4028**	4.34%	7.97%
PTR	0.6872*	0.786*	7.73%	17.46%	0.9695*	1.0015*	32.98%	29.33%
SCD	0.5062*	0.9540*	10.19%	39.59%	0.5875*	0.7208*	19.19%	28.64%

Since the correlation between trading frequency and monthly beta drops substantially compared to the correlation between trading frequency and daily beta, Armitage and Brzeszczyński (2011) argued that monthly returns greatly alleviate the bias cause by the price adjustment delay factors, in particular by the nonsynchronous trading. The results of this study show that the correlation between trading frequency and beta estimate is 0.71 for daily data and 0.71 for monthly data in the first period. For the second period, the correlations are 0.84 and 0.73. Therefore, the result suggests that the monthly returns used to estimate beta coefficients do not diminish the bias. As a consequence, it appears that the return interval should be lengthened more to obtain reliable beta estimates for the stock listed on the Romanian stock market.

Table II presents in addition the values of determination coefficients. For the first period, in general, the monthly determination coefficients are higher than the daily ones. The mean (median) difference is 12.04% (12.24%) with a range between -13.67% and 34.11%. The mean (median) of determination coefficients increases from 9.43% (4.53%) using daily returns to 21.47% (17.54%) using monthly returns. In percentage terms, the mean (median) of the determination coefficients increases with 128% (287%). For the second period, the results are similar. Generally, the monthly determination coefficients are higher compared to the daily ones. These results are in line with those of other studies (Brailsford and Josev, 1997; Brzeszczyński et al., 2011). Up to this point, the results suggest that for most of the stocks listed on the Romanian stock market the daily beta estimates are downward biased. Also, the results show that the monthly returns do not alleviate the downward bias caused by market frictions.

Table II: OLS beta estimates and R-squared (b)								
BSE code	Daily beta	Monthly beta	Daily R-suqred	Monthly R-squared	Daily beta	Monthly beta	Daily R-squared	Monthly R-squared
	2002-2006				2007-2011			
SIF1	0.9902*	1.1230*	25.51%	47.62%	1.1600*	1.1636*	54.48%	61.80%
SIF2	0.9905*	1.2499*	23.62%	38.74%	1.2353*	1.3799*	59.27%	70.55%
SIF3	0.9174*	1.1367*	22.80%	56.90%	1.1755*	1.2109*	50.77%	54.94%
SIF4	0.9210*	1.0601*	21.79%	44.39%	1.0621*	0.8981*	52.79%	53.51%
SIF5	1.0055*	1.3282*	24.80%	53.32%	1.1898*	1.3205*	56.28%	71.04%
SNO	0.3387*	0.7338*	1.93%	20.01%	0.7694*	0.8086*	18.38%	35.97%
SNP	1.4069*	1.3619*	60.24%	76.37%	1.0404*	1.0029*	63.47%	74.38%
SRT	0.5601*	0.7191*	4.89%	12.57%	0.5538*	0.5974*	7.76%	20.42%
STZ	0.6388*	0.8063*	4.76%	17.54%	0.3367*	0.4272**	2.78%	8.91%
TBM	0.4451*	0.7150*	5.34%	12.46%	0.9562*	1.2188*	26.78%	63.05%
TLV	0.8904*	0.9321*	28.47%	22.02%	0.7883*	0.8245*	33.42%	21.75%
UAM	0.3737*	0.3990***	1.51%	5.54%	0.2758*	0.8691*	1.98%	33.02%
UCM	0.0174	0.0923	0.00%	0.00%	0.0327	0.1896	0.00%	0.00%
ZIM	0.2336*	0.5605*	0.85%	14.58%	0.2113*	0.5440**	1.34%	8.37%
Average	0.5290	0.6839	9.43%	21.47%	0.6554	0.8381	20.01%	31.89%

Notes:*, ** and *** indicates significance at 1%, 5% and 10% respectively.

However, on average, the beta estimates increase using monthly returns compared to daily returns. In the next analysis, the present study investigates the impact of some stock characteristics like market capitalization and trading intensity on the observed differences between monthly and daily beta estimates. These results are presented in Table III.

Table III: The magnitude of the interval effect					
2002-2006			**2007-2011**		
c	**ln(CAP)**	**R-squared**	**c**	**ln(CAP)**	**R-squared**
0.7200**	-0.0265	6.87%	1.0091*	-0.0425*	21.72%
(2.2173)	(-1.5117)		(3.7996)	(-3.0255)	
c	**FREQ**	**R-squared**	**c**	**FREQ**	**R-squared**
0.5157*	-0.3386	7.20%	0.5805*	-0.4673*	26.91%
(2.7700)	(-1.5506)		(5.2859)	(-3.4861)	
c	**ln(VOL)**	**R-squared**	**c**	**ln(VOL)**	**R-squared**
0.3631**	-0.0117	2.52%	0.6145*	-0.0365*	31.23%
(2.4086)	(-0.8949)		(5.6959)	(-3.8712)	
c	**ln(TRANS)**	**R-squared**	**c**	**ln(TRANS)**	**R-squared**
0.3207*	-0.0275	5.90%	0.4144*	-0.0637*	37.40%
(4.4389)	(-1.3945)		(7.8493)	(-4.4402)	

Notes: Table 3 depicts the results of the cross-section analysis where the dependent variable is the difference between the monthly and daily beta previously estimated. The study uses only the stocks for which both the daily and monthly beta estimates are statistically significant. Therefore, for the first period the sample contains 33 observations and for the second period 35 observations. The explicative variables are some characteristics of stocks like: market capitalization (CAP), trading frequency (FREQ), trading volume (VOL) and number of trades (TRANS). CAP is computed as the mean daily market capitalization. FREQ is calculated as the ratio between the number of days in which a stock was traded and the total number of possible days of trading for each analyzed period. VOL is computed as the mean daily trading volume. TRANS is computed as the mean daily number of trades. This study employs only the simple regression because the coefficients of correlation between the explicative variables are high (see also section 3.2). This procedure is followed to avoid any problem of multicollinearity. t-statistic is reported in the brackets. C are the regression intercepts. ln() represents the natural logarithm operator. *, ** and *** indicates significance at 1%, 5% and 10%, respectively.

In the first period, all the slope coefficients are not statistically significant. This result suggests that the increase of monthly beta compared to daily beta is not attributed to market

capitalization or trading intensity. In other words, the increase of beta estimates from daily to monthly data is not more pronounced for the companies with the smallest market capitalization. Also, the magnitude of the interval effect is not larger for the companies with less traded stocks.

In the second period, another picture emerged given that all the slopes are statistically significant. Although partially, the results suggest that the difference between monthly beta and daily beta is larger for the companies with relatively small market capitalization, low number of trading days, low trading volume and a low daily number of trades. This evidence could imply that these stocks have their betas very underestimated when shorter return intervals (e.g., daily) are used in estimation and in such a case they should be subjected to an upward adjustment. Similar finding was reported by Brzeszczyński et al. (2011) for the Polish stock market.

5. CONCLUSIONS

This paper investigates the sensitivity of beta coefficient to the length of the return interval for the stocks listed on the Romanian stock market. The results suggest the presence of the interval effect. Generally, the monthly beta estimates are higher compared to the daily ones but, for few stocks the monthly beta estimates are smaller than the daily ones.

Cohen et al. (1980) link the above phenomena to friction in the trading process, which causes delays in response of a security's price to informational change. Moreover, Cohen et al. (1980) claim that the greater (less) is the delay of the security relative to the weighted average delayed in the market, the more will be downward (upward) biased the beta estimate compared with the true beta, when a smaller return interval is used in estimation (e.g. daily returns).However, when the return interval is lengthened, the impact of market frictions is reduced and less bias is introduced in beta estimation.

The results of this study show that for most of Romania stocks the daily beta estimates suffer from a downward bias cause by the friction in the trading process. As such, some stocks may appear to be less or more risky than they truly are when shorter return intervals are used to estimate the beta coefficients. Although, it is considered that the monthly returns greatly alleviate the downward (upward) bias problem, it appears that, in the Romanian case, the return interval should be lengthened more to obtain reliable estimates for the beta coefficients.

Furthermore, this study examines the difference between beta coefficients calculated from monthly returns and daily returns. Although partially, the results suggest that the difference between monthly beta and daily beta is larger for companies with relatively small market capitalization and less traded stocks. Therefore, for these companies the beta estimates could be highly underestimated when short return intervals (e.g., daily) are used in estimation. In such a case, they should eventually be subject to an upward adjustment.

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