Sectoral Differentiation of the Interval Effect in the Time of the COVID-19 Pandemic: The Case of WSE

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Abstract The occurrence of differences in the values of the β depends on the adopted returns. In the literature this has been called the interval effect. The main objective of this paper is to verify the existence of the differentiation of the beta coefficient (β) interval effect of shares of companies listed on the Warsaw Stock Exchange (WSE) during the COVID-19 pandemic due to their macro sectoral affiliation. The β is calculated using the ordinary least squares method (OLS) on the sample of issuers grouped in the following indices: WIG20, mWIG40 and sWIG80. By analyzing the β values estimated on the different time horizons of returns has been observed the occurrence of the β interval effect in the years of the COVID-19 pandemic. Finance and Industrial Production did not indicate statistically significant differences between the β values calculated for different time horizons of returns in the pre-pandemic years. However, in these years, the interval effect has been recorded in the case of Healthcare and Trade and Services. Based on the research results obtained, the impact of the COVID-19 pandemic on the sectoral differentiation of the interval effect can be observed.

Keywords:
interval effect, beta coefficient, COVID-19, Warsaw Stock Exchange, shares.

JEL:
C20, G11, G17

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1 Introduction

One of the parameters of the Sharpe model is the beta coefficient (β). It reflects the non-diversifiable part of the volatility of returns. The process of its estimation is associated with numerous difficulties (Feder-Sempach, 2017, 20-21). One of them is indication of the returns' interval used to calculate it. When using different time intervals (from daily to several years) to calculate β, significant differences in estimates were noticed. The occurrence of these differences in the values of the β depends on the adopted period of the used share quotations of companies, which has been called the interval effect.

The main purpose of this article is to verify the occurrence of differentiation of the interval effect in the time of the COVID-19 pandemic (2020-2021). It will be conducted from the point of view of the affiliation of issuers to selected macro sectors listed on the Warsaw Stock Exchange (WSE). Moreover, the β values calculated for 2020-2021 (using daily, weekly, biweekly and monthly returns) for issuers from individual macro sectors will be compared with those recorded in 2018-2019.

The research will allow to deepen the knowledge of Polish capital market participants in the scope of the possibility of using β to measure the systematic risk of shares listed on the WSE in times of instability on capital markets.

2 Literature Review

Choosing the right timeframe to measure returns was of interest to researchers as early as the 1970s. The first empirical study showing the differences in β was carried out by Pogue and Solnik (1974). They analyzed the aforementioned coefficients on the American and seven European capital markets and diagnosed the occurrence of a range effect (measured by the quotient of the monthly and daily β value) for the above-mentioned markets.

The authors of next studies noticed interesting conclusions. Hawawini (1983) and Handa et al. (1989) noticed the differentiation of the β interval effect depending on the capitalization of companies. The interval effect was also tested in European capital markets. When examining companies listed on the Brussels Stock Exchange,

it was noticed that the values of β depend on the day adopted for the first day of verification of the interval effect (Corhay, 1992). The observations relating to the occurrence of the interval effect have been confirmed also in the Australian market (Brailsford & Josev, 1997).

In terms of the WSE, there have been some really interesting publications on the interval effect also. Among the first papers were the studies by Brzeszczyński et al. (2010). The authors estimated the effect of the interval for 1-, 5-, 10-, and 21-day returns on stocks. The comparative analysis of the interval effect on the example of shares of companies from the WIG20 index and the German DAX (Feder-Sempach, 2017) or a study of the impact of the COVID-19 pandemic on stock market risk measured by the β (Lisicki, 2023).

In recent years, one can also find research on sectoral differences in the value of β depending on the time horizon of the returns (Dadakas et al., 2016), which is thematically closest to this paper. The authors also pointed out that the prediction of returns depends on the sector (Westerlund & Narayan, 2015). Also, in the times of the COVID-19 pandemic it is possible to observe the attempts to quantify β of securities listed on many global capital markets in the era of increased uncertainty that accompanies years 2020-2021 (Neslihanoglu, 2021). Similarly to the β analysis in previous crisis periods, the values of this coefficients increased during the COVID-19 pandemic, especially in its first phase (Jain, 2021). Moreover, it was possible to indicate industries in which their values increased higher than in others (e.g. IT, insurance, consumer goods). In another study, the authors have been observed decreases in β values during the pandemic years for small and medium-sized companies (Hua Cao et al., 2021).

3 Methodology

The interval effect has been verified by calculating the β for shares of selected issuers from the WIG index. Research sample has been narrowed to the 140 largest companies grouped in the three main WSE indices: WIG20 (which groups 20 the biggest issuers in the WSE), mWIG40 (40 medium-size issuers) and sWIG80 (80 small issuers). Author decided to use the historical portfolios of these indices as of the first quarter of 2020 (WSE, 2020). β has been calculated using the OLS (*Ordinary Least Squares*) method for the daily, weekly, biweekly and monthly returns. The WIG

index (broad market index of WSE) has been used to indicate the market return. The period of analysis covers years of the outbreak and duration of the COVID-19 pandemic (2020-2021) and years immediately preceding it (2018-2019). The quotations (used to calculate the β) of shares of the indicated issuers have been downloaded from the stooq.com (2022) quotation database.
In the paper the industry of issuers from the point of view of 8 macro sectors distinguished with the WSE Sector Classification Regulations of July 24, 2019 has been considered.

4 Results and Discussion

The average values of the β calculated for four-time horizons of returns (daily, weekly, biweekly and monthly) in connection to macro sectors are presented in Table 1. The numbers of issuers qualified for the study are also presented in brackets. Due to the fact that shares of selected issuers were not listed on the Warsaw Stock Exchange throughout the whole period of the study (2018-2021) finally qualified 115 issuers to the research sample.

Analyzing the data contained in Table 1, it is possible to indicate that the average values of β for the two analyzed periods increase along with the lengthening of the time horizon of the return for major part of the indicated macro sectors. This result is similar with the discoveries made by researchers in this area (Diacogiannis et al., 2008; Brzeszczyński et al., 2011).

The highest average β values in 2020-2021 can be observed for issuers from the FINANCE macrosector (weekly, biweekly and monthly returns) and CHEMICALS AND RAW MATERIALS (daily returns). Especially for FINANCE macro sector, the research results are similar with the results conducted in other capital markets. Shares of financial companies that were characterized by higher than average volatility β in times of crisis (Haroon et al. 2021). The lowest β values can be observed in 2020-2021 (for all time horizons) in the case of issuers from the TECHNOLOGIES macro sector. These issuers have been indicated usually on the Polish market as having lower β values (Feder-Sempach & Szczepocki, 2022). In 2018-2019, the highest averaged value of β occurred for issuers in the macro sectors: CHEMICALS AND RAW MATERIALS (weekly and monthly returns), TRADE AND SERVICES (biweekly returns) and FUELS AND ENERGY (daily returns).

The lowest value can be observed for issuers grouped in the macro sectors: CONSUMER GOODS (biweekly and monthly returns), INDUSTRIAL PRODUCTION (weekly returns) and HEALTHCARE (daily returns).

Table 1. Average values of β coefficients for selected issuers listed on the WSE in 2020-2021 and 2018-2019

2020-2021				
β/Macrosector	**Beta daily**	**Beta weekly**	**Beta biweekly**	**Beta monthly**
FINANCE (22)	0.969	1.023	1.192	1.239
FUEL AND ENERGY (13)	0.890	0.957	0.988	0.917
CHEMISTRY AND RAW MATERIALS (11)	0.991	0.996	1.048	1.038
INDUSTRIAL PRODUCTION (20)	0.853	0.954	1.120	1.216
CONSUMER GOODS (14)	0.894	1.001	1.190	1.138
TRADE AND SERVICE (17)	0.835	0.979	0.987	0.949
HEALTHCARE (8)	0.937	0.954	0.683	0.740
TECHNOLOGIES (10)	0.687	0.641	0.576	0.564
AVERAGE FOR ALL	**0.882**	**0.938**	**0.973**	**0.975**
2018-2019				
FINANCE (22)	0.671	0.710	0.808	0.778
FUEL AND ENERGY (13)	0.781	0.828	0.672	0.752
CHEMISTRY AND RAW MATERIALS (11)	0.712	0.945	0.876	0.923
INDUSTRIAL PRODUCTION (20)	0.392	0.519	0.696	0.696
CONSUMER GOODS (14)	0.511	0.603	0.668	0.529
TRADE AND SERVICE (17)	0.557	0.811	0.898	0.724
HEALTHCARE (8)	0.195	0.565	0.718	0.708
TECHNOLOGIES (10)	0.463	0.594	0.699	0.705
AVERAGE FOR ALL	**0.535**	**0.697**	**0.754**	**0.727**

Source: Author's calculations based on stooq.com (accessed: 20.07-22.08.2022).

Consequently, it is possible to indicate that the COVID-19 pandemic affected the levels of β in macrosectors. It caused a different (usually stronger, positively correlated) average reaction of stock quotations of issuers from individual sectors (as a result of a change in the market index by one percentage point). These research results somehow confirm the previous results indicating the differentiation of the β value due to sectors (Liu, 2004).

Table 2. Values of the t-Stat statistics for differences between the β for shares of issuers from WSE macrosectors in 2018-2021

Pair of β/ Macrosector	β daily β weekly	β daily β biweekly	β daily β monthly	β weekly β biweekly	β weekly β monthly	β biweekly β monthly
2020-2021						
FINANCE	-0.49	-1.91**	-2.27*	-1.46	-1.82**	-0.38
FUEL AND ENERGY	-0.38	-0.56	-0.12	-0.16	0.18	0.31
CHEMISTRY AND RAW MATERIALS	0.02	0.36	0.39	0.38	-0.24	0.07
INDUSTRIAL PRODUCTION	-0.71	-1.69**	-2.3*	-0.97	-1.73**	-0.52
CONSUMER GOODS	-0.72	-1.64	-1.1	-0.97	-0.59	0.21
TRADE AND SERVICE	-0.81	-0.75	-0.43	-0.04	0.1	0.13
HEALTHCARE	-0.09	1.58	0.84	1.45	0.85	-0.26
TECHNOLOGIES	0.39	0.94	0.92	0.51	0.55	0.09
2018-2019						
FINANCE	-0.33	-1.2	-0.75	-0.91	-0.5	0.22
CHEMISTRY AND RAW MATERIALS	-1.14	-0.79	-0.83	0.31	0.07	-0.18
INDUSTRIAL PRODUCTION	-1.05	-2.04**	-1.37	-1.06	-0.76	0.01
CONSUMER GOODS	-0.71	-1.17	-0.13	-0.45	0.5	0.91
TRADE AND SERVICE	-1.7**	-1.89**	-0.85	-0.41	0.39	0.74
HEALTHCARE	-2.2*	-3.02*	-1.86**	-0.83	-0.5	0.03
TECHNOLOGIES	-1.03	-1.78**	-1.2	-0.76	-0.54	-0.03

** $p<0.1$

* $p<0.05$

Source: Author's calculations based on stooq.com (accessed: 20.07.-22.08.2022).

After evaluating the averaged β next part of the paper cover a verification of statistical significance their differences. For this purpose, a test will be used to check the significance of differences between two dependent groups. Suitable statistical test to this case should be a parametric *t-test for dependent groups* (Kyun, 2015, p. 52) for each 6 pairs of β calculated for a different time horizon of returns (separately for each macro sector and period). For its implementation, it is required to meet the assumption of the normality of variable distribution. For the adopted research

sample it has been positively verified for each macro sector using the D'Agostino-Pearson normality test (D'Agostino et al., 1990, 320). The results of the statistical verification have been presented in Table 2, which includes the values of the t-test statistic (t-Stat) and their significance level (two-tailed p-value-if it was lower than $p<0.10$).

Analyzing the results of the statistical verification presented in Table 2, it can be observed a significant differentiation of the β values. It concerns especially in 2020-2021 issuers grouped in the macro sectors: FINANCE and INDUSTRIAL PRODUCTION. Therefore, it indicates the possibility of the occurrence of the β interval effect. It is also important that for the FINANCE macro sector in 2018-2019 no statistical significance of differences β was demonstrated for any of the analyzed pairs of coefficients and for the INDUSTRIAL PRODUCTION macro sector the significance was observed only for one of the pairs of coefficients. It is probably to conclude that the occurrence of the β-interval effect in the case of these two sectors could be related with the occurrence of the COVID-19 pandemic, because in the pre-pandemic years these relationships were not similar. This result is also justified by previous studies, in which researchers indicated increased β volatility of industrial Asian companies during the Asian crisis in 1997-1998 (Choudhry et al., 2010) and companies from the broadly understood financial sector during the pandemic COVID-19 in the Indian market (Jain, 2021).

4 Conclusions

The pandemic realities created incentives to verify the dependencies noticed on the capital markets in previous years (Ruiz Estrada, Koutronas, Minsoo, 2021). This is undoubtedly an attempt to verify the sectoral differentiation of the interval effect on the example of the macro sectors of companies listed on the WSE.

Verification of the sectoral differentiation of the interval effect has been taken place on a sample of 115 issuers listed on WSE. For each of them, based on the OLS method, the β were calculated each time for daily, weekly, biweekly and monthly returns. The presented β values show significant differences when comparing periods 2020-2021 and 2018-2019, which is especially noticeable for the macro sectors CONSUMER GOODS, INDUSTRIAL PRODUCTION and FINANCE. In addition, the statistical verification of differences in the β estimated using four-

time horizons of returns, showed that for two of these sectors (INDUSTRIAL PRODUCTION and FINANCE) during the COVID-19 pandemic years an interval effect has been observed. Moreover, in the pre-pandemic years, a similar relationship did not exist, but it could be observed for issuers from other macro sectors. Based on these research results, it can be concluded that the COVID-19 pandemic influenced the sectoral differentiation of the occurrence of the β interval effect, which in 2020-2021 applies to other industries than in 2018-2019.

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