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Introduction

One of the fastest growing areas in the economic sciences is broadly defined area of finance, with particular emphasis on the financial markets, financial institutions and risk management. Real world challenges stimulate the development of new theories and methods. A large part of the theoretical research concerns the analysis of the risk of not only economic entities, but also households.

The first Wrocław Conference in Finance WROFIN was held in Wrocław between 22nd and 24th of September 2015. The participants of the conference were the leading representatives of academia, practitioners at corporate finance, financial and insurance markets. The conference is a continuation of the two long-standing conferences: INVEST (Financial Investments and Insurance) and ZAFIN (Financial Management – Theory and Practice).

The Conference constitutes a vibrant forum for presenting scientific ideas and results of new research in the areas of investment theory, financial markets, banking, corporate finance, insurance and risk management. Much emphasis is put on practical issues within the fields of finance and insurance. The conference was organized by Finance Management Institute of the Wrocław University of Economics. Scientific Committee of the conference consisted of prof. Diarmuid Bradley, prof. dr hab. Jan Czekaj, prof. dr hab. Andrzej Gospodarowicz, prof. dr hab. Krzysztof Jajuga, prof. dr hab. Adam Kopiński, prof. dr. Hermann Locarek-Junge, prof. dr hab. Monika Marcinkowska, prof. dr hab. Paweł Miłobędzki, prof. dr hab. Jan Monkiewicz, prof. dr Lucjan T. Orłowski, prof. dr hab. Stanisław Owskiak, prof. dr hab. Wanda Ronka-Chmielowiec, prof. dr hab. Jerzy Różański, prof. dr hab. Andrzej Sławiński, dr hab. Tomasz Słoński, prof. Karsten Staehr, prof. dr hab. Jerzy Węclawski, prof. dr hab. Małgorzata Zaleska and prof. dr hab. Dariusz Zarzecki. The Committee on Financial Sciences of Polish Academy of Sciences held the patronage of content and the Rector of the University of Economics in Wrocław, Prof. Andrzej Gospodarowicz, held the honorary patronage.

The conference was attended by about 120 persons representing the academic, financial and insurance sector, including several people from abroad. During the conference 45 papers on finance and insurance, all in English, were presented. There were also 26 posters.

This publication contains 27 articles. They are listed in alphabetical order. The editors of the book on behalf of the authors and themselves express their deep gratitude to the reviewers of articles – Professors: Jacek Batóg, Joanna Bruzda, Katarzyna Byrka-Kita, Jerzy Dzieża, Teresa Famulska, Piotr Fiszeder, Jerzy Gajdka, Marek Gruszczyński, Magdalena Jerzemowska, Jarosław Kubiak, Tadeusz Kufel, Jacek Li-

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DIRECT EVIDENCE OF NON-TRADING ON THE WARSAW STOCK EXCHANGE

PROBLEM BRAKU TRANSAKCJI NA GIEŁDZIE PAPIERÓW WARTOŚCIOWYCH W WARSZAWIE

DOI: 10.15611/pn.2016.428.16

JEL Classification: C10, G01, G11, G12, G14

Abstract: This paper documents the frequency of non-trading for the Warsaw Stock Exchange (WSE) listed stocks. The methodology builds on Foerster and Keim [1993] and refers to non-trading as the lack of transactions over a particular period when the WSE is open for trading. The non-trading frequency for each company is examined based on both the daily trading volume (in items) and the ratio of the number of non-traded days to the total number of trading days during the period investigated. The whole sample of the period January 2005 – December 2014 and three adjacent sub-periods of equal size: the pre-crisis, crisis, and post-crisis period, are analysed. The Global Financial Crisis on the WSE is formally established as the period of June 2007–February 2009. The research hypothesis that the frequency of non-trading does not depend on the firms' size is tested. The empirical results indicate no reason to reject this hypothesis on the WSE and are rather robust to the choice of the sample.

Keywords: market microstructure, non-trading, Warsaw Stock Exchange, financial crisis, firm size effect.

Streszczenie: W artykule analizuje się problem braku transakcji dla spółek notowanych na Giełdzie Papierów Wartościowych w Warszawie S.A. Metodyka badania opiera się na pracy Foerster, Keim [1993]. Problem braku transakcji dla każdej ze spółek jest badany na podstawie obserwacji dziennego wolumenu oraz współczynnika wyrażającego stosunek liczby dni bez transakcji do liczby wszystkich dni transakcyjnych w danym okresie. Próba statystyczna obejmuje okres od stycznia 2005 r. do grudnia 2014 r., z wyszczególnieniem podokresów: przed kryzysem, kryzys, po kryzysie. Testowana hipoteza badawcza zakłada, że problem braku transakcji na polskim rynku kapitałowym nie zależy od wielkości spółki. Wyniki empiryczne wskazują brak przesłanek do falsyfikacji tej hipotezy oraz wykazują odporność na wybór okresu badania.

Słowa kluczowe: mikrostruktura rynku, problem braku transakcji, Giełda Papierów Wartościowych w Warszawie S.A., kryzys, efekt wielkości spółki.

1. Introduction

The market microstructure literature is far too vast to give a complete citation list. There are some monographs that provide a fairly complete treatment of the major issues and models in this literature (e.g. [Campbell et al. 1997; O'Hara 1995; Harris 2003; Hasbrouck 2007; De Jong, Rindi 2009; Doman 2011; Olbryś 2014a]). Generally speaking, the studies on stock market microstructure treat the interplay between the market participants, trading mechanisms, and the dynamic behaviour of security prices in a regime where various frictions impede the trading processes. Many researchers place nonsynchronous trading, bid/ask spread, other transaction costs, etc., in a broad class of market frictions (e.g. [Cohen et al. 1980; Campbell et al. 1997; Stoll 2000; Tsay 2010; Olbryś 2014a, 2014c]) and references therein. In the literature, frictions are understood as various disturbances in trading processes. In general, market frictions cause a delay between the arrival of information and its reflection in the observed stock returns – the so-called price adjustment delay. Essentially, this problem is one of the most important ones, as Fama stressed that “(...) a frictionless market in which all information is freely available and investors agree on its implications is, of course, not descriptive of markets met in practice (...)” [1970, p. 387]¹.

Market frictions may be detected by a direct measurement, which is possible when intraday trading data is available. For example, the Trades and Quotes (TAQ) database of the New York Stock Exchange (NYSE) contains all equity transactions on the NYSE, AMEX, NASDAQ, and the regional exchanges, from 1992 to the present [Tsay 2010, p. 231]. High frequency financial data is important in studying a variety of issues related to the trading process and market microstructure. Due to the lack of access to intraday trading data, a direct measurement of frictions is difficult, or even impossible, especially in the case of most emerging stock markets (e.g. [Bekaert et al. 2007; Olbryś 2013b, 2014a, 2014c; Nowak 2014]). Therefore, indirect identification of a probable presence of market frictions may be provided by detecting the existence of some empirical phenomena, which can be treated as the consequences of market frictions (e.g. [Fisher 1966; Scholes, Williams 1977; Dimson 1979; Cohen et al. 1980; Hawawini 1980; Dimson, Marsh 1983; Perry 1985; Atchison et al. 1987; Lo, MacKinlay 1990; Schwert 1990; Mech 1993; Campbell et al. 1993; Boudoukh et al. 1994; Campbell et al. 1997; Kadlec, Patterson 1999; Olbryś, Majewska 2014a; Olbryś 2014a, 2014b; Chelley-Steeley, Steeley 2014]). Two common elements among most of the phenomena are evident. These are: the intervalling effect and the impact of a security's 'thinness' (the so-called 'size effect').

It is pertinent to note that the presence of various frictions in trading processes has some crucial theoretical and empirical implications. Among others, it confirms

¹ Professor Eugene F. Fama was awarded the 2013 Nobel Prize in Economic Sciences (together with L.P. Hansen and R.J. Shiller).

market illiquidity, and therefore it plays a significant role in asset pricing (e.g. [Bekaert et al. 2007; Olbryś 2014a, 2014c]). Due to the importance of the problem, the main goal of this paper is to directly identify non-trading on the Warsaw Stock Exchange (WSE). We refer to non-trading as a lack of transactions over a particular period when the WSE is open for trading. Our methodology builds on Foerster and Keim [1993]. We explicitly test the research hypothesis that the frequency of non-trading does not depend on the firms' size. A statistical test is employed to measure the significance of the difference between two means of the ratio of the number of non-traded days to the total number of trading days during the period investigated, among the groups of stocks.

The analysis of the non-trading problem both in the whole sample January 2005 – December 2014 (ten years) and over three adjacent sub-periods of equal size: (1) the pre-crisis period of September 2005 – May 2007, (2) the crisis period of June 2007 – February 2009, and (3) the post-crisis period of March 2009 – November 2010, is provided. The period of The Global Financial Crisis on the WSE was formally established based on the paper [Olbryś, Majewska 2014b], in which the Pagan-Sossounov [2003] method for direct statistical identification of market states was employed.

We find that the average amount of non-trading is not significantly larger for smaller firms. Therefore, we do not confirm heterogeneity of non-trading among stocks in the context of size effects. The empirical results indicate no reason to reject the research hypothesis that the frequency of non-trading does not depend on a firm's size on the WSE. Moreover, the shareholder structure of the companies with the highest ratio of the number of non-traded days to the total number of trading days was analysed. The empirical results for the Warsaw Stock Exchange are novel and, to the best of authors' knowledge, have not been presented in the literature thus far.

The remainder of this study is organized as follows. Section 2 presents the non-trading problem and its implications. In Section 3, we present and discuss the results documenting the frequency of non-trading in the WSE. In Section 4, we focus on the sensitivity of empirical results to firm's size and test the research hypothesis. Section 5 recalls the main findings and presents the conclusions.

2. The non-trading problem and its implications

Some studies distinguish between two problems caused by nonsynchronous trading, see e.g. [Olbryś 2013a] and the references therein. The first problem, called the 'nonsynchronous trading effect I', occurs when the analysis of one selected domestic market is conducted. The second problem, referred to as the 'nonsynchronous trading effect II', occurs when the relationships among stock markets in various countries are analysed. Therefore, as the research concentrates on the Polish stock market, the nonsynchronous trading effect I is examined.

This effect arises when time series, usually asset prices, are taken to be recorded at time intervals of one length while in fact they are recorded at time intervals of other, possibly irregular, lengths [Campbell et al. 1997, p. 84]. The non-trading problem, i.e. the lack of transactions, which means that the volume (in items) is equal to zero, may be treated as a special case of the nonsynchronous trading effect I.

The consequences of non-trading have been widely recognized in the literature (e.g. [Fisher 1966; Scholes, Williams 1977; Dimson 1979; Cohen et al. 1980; Dimson, Marsh 1983; Perry 1985; Atchison et al. 1987; Lo, MacKinlay 1990; Schwert 1990; Campbell et al. 1997; Kadlec, Patterson 1999; Olbrys, Majewska 2014a; Olbrys 2014a, 2014b, 2014c; Chelley-Steeley, Steeley 2014]). It is a well-known fact that the non-trading effect induces potentially serious biases in various statistical measures of asset returns. Moreover, a positive serial correlation in market index returns, with the smallest effect for long differencing intervals and those indexes and portfolios giving the least weight to returns on securities with low trade volumes – the so-called Fisher effect [1966], can be attributed to the non-trading evidence. The empirical results presented in [Olbrys 2011; Olbrys, Majewska 2014a; Olbrys 2014a] show that a pronounced problem of serial correlation in daily logarithmic returns of the WSE main indexes is present. Besides the Fisher effect, the non-trading problem can induce intertemporal (noncontemporaneous) cross-correlations between pairs of securities' daily returns (e.g. [Hawawini 1980; Olbrys 2011]).

Another important strand of the literature regards the effect of serial autocorrelation and cross-correlation in security returns (e.g. [Cohen et al. 1980; Scholes, Williams 1977; Lo, MacKinlay 1990; Campbell et al. 1993; Boudoukh et al. 1994; Nowak, Olbrys 2015]). Moreover, it is pertinent to mention the impact of infrequent trading on risk measurement, i.e. the instability problem of systematic risk parameters, the so-called beta interval effect (e.g. [Scholes, Williams 1977; Dimson 1979; Cohen et al. 1980; Dimson, Marsh 1983]). According to the literature, this effect is present on the WSE (e.g. [Brzeszczyński et al. 2011; Olbrys 2014a]).

Furthermore, another phenomenon is the impact of the return interval on the determination coefficient of a market model, which is known as the intervalling effect in R-squared. The empirical results presented in [Olbrys 2014b] confirm that there is no reason to reject the hypothesis that the so-called R-squared interval effect is present on the WSE.

3. Direct evidence of non-trading on the Warsaw Stock Exchange

In this research, a database containing data for the WSE-listed stocks for the period from January 2, 2005 to December 30, 2014 was utilized. When forming the database, we included only those securities which existed on the WSE for the whole sample period since December 31, 2004, and were not suspended (e.g. [Mech 1993; Olbrys 2014a]). Finally, 147 WSE-listed companies were entered into the database [Nowak, Olbrys 2015]. The stock prices and daily trading volumes (in items) were obtained

from <http://www.gpwinfostrefa.pl>. Data of the companies' shareholder structure is coming from the Thomson Reuters Eikon database under the partnership agreement between Thomson Reuters and the University of Gdansk.

Foerster and Keim [1993] documented the frequency of non-trading for the NYSE and AMEX stocks over the period of 1926 to 1990. They used daily and monthly stock price files provided by the commercial CRSP database².

As pointed out earlier, the main goal of this paper is to document cross-time and cross-security patterns in non-trading among the WSE-listed stocks. To address this issue, we investigate the non-trading problem in the whole sample period of January 2005 – December 2014, and three adjacent sub-periods of equal size: the pre-crisis, crisis, and post-crisis period. The methodology builds on Foerster and Keim [1993], however, the analysis refers to non-trading as a lack of transactions over a particular period³. Therefore, we examine the non-trading frequency based on both the daily trading volume (in items) and the ratio of the number of non-traded days to the total number of trading days during the period investigated.

As mentioned in Introduction, the crisis period on the Warsaw Stock Exchange was formally established based on the paper [Olbryś, Majewska 2014b], in which the Pagan–Sossounov [Pagan, Sossounov 2003] method for direct statistical identification of market states was employed. The empirical results indicated that June 2007 – February 2009 was The Global Financial Crisis period for the WSE. For comparison, we investigate the frequency of non-trading on the WSE over three adjacent sub-periods of equal size (436 days): (1) the pre-crisis period of September 6, 2005 – May 31, 2007, (2) the crisis period of June 1, 2007 – February 27, 2009, and (3) the post-crisis period of March 2, 2009 – November 19, 2010.

Figures 1 and 2 present the average trading daily volume and the average ratio of the number of non-traded days to the total number of trading days for the groups of stocks, in the whole sample (P1) and three adjacent sub-samples (P2, P3, P4), respectively. The methodology of dividing the stocks into SMALL, MEDIUM and BIG groups is described in detail in the next section.

The values of the average daily trading volume (Figure 1) are rather typical, but the results presented in Figure 2 are worth a comment in the context of the size effects. One can observe that the average frequency of non-trading measured by the ratio is not meaningfully larger for small firms, except for the whole sample period (P1), when it amounts to about 4.56 percent, whereas the average ratios for the medium and big firms are equal to 1.38 and 2.73 percent, respectively. Moreover, the average ratio for big companies is surprisingly high in all periods investigated. For example, it amounts to 3.31 percent on average over the post-crisis period (P4).

² CRSP – the Center for Research in Security Prices.

³ Foerster and Keim use the CRSP database and identify the non-traded stocks by the negative value of the average of the last bid and ask price, according to the CRSP convention for recording the prices of non-traded securities.

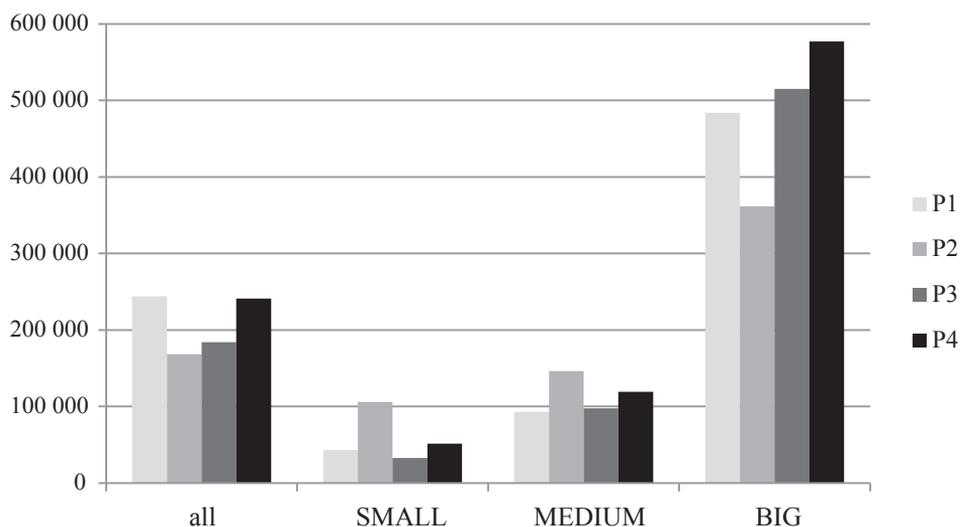


Figure 1. Average trading daily volume

Source: Authors' own study.

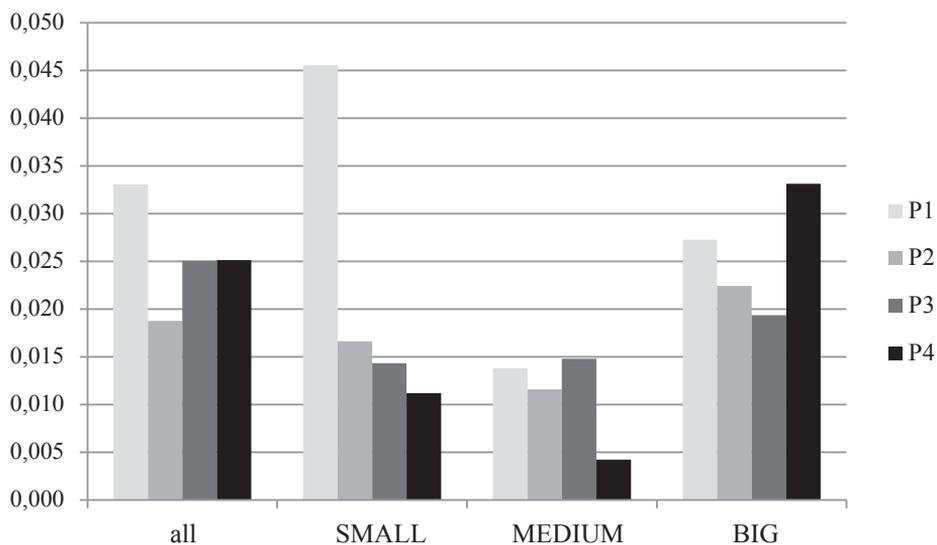


Figure 2. Average ratio of the number of non-traded days to the total number of trading days

Source: Authors' own study.

Table 1 provides more detailed findings regarding the number of non-traded days of the WSE-listed companies divided into groups based on the firm's size.

Table 1. The number of WSE-listed stocks with particular amount of non-traded days divided according to firm's size (small medium, big) and period (P1, P2, P3, P4)

Non-tr.d.	P1			Non-tr.d.	P2			P3			P4		
	S	M	B		S	M	B	S	M	B	S	M	B
0	2	5	17	0	27	32	31	25	32	33	24	33	32
(0; 2]	2	6	7	(0; 1]	4	9	4	4	3	2	7	8	2
(2; 12]	7	12	7	(1; 3]	4	5	1	3	6	2	2	5	3
(12; 20]	5	7	4	(3; 10]	3	6	4	5	6	0	5	7	1
(20; 40]	6	6	2	(10; 30]	1	3	2	5	8	3	3	3	4
(40; 80]	8	10	1	(30; 60]	4	2	0	1	2	3	1	1	0
(80; 150]	7	7	3	above 60	1	2	2	1	2	1	2	2	2
(150; 250]	4	2	1	sum	44	59	44	44	59	44	44	59	44
above 250	3	4	2										
sum	44	59	44										

Note: Non-tr.d. – non-traded days (in intervals); P1 – the whole sample period January 3, 2005 – December 30, 2014 (2502 days), P2 – the pre-crisis period September 6, 2005 – May 31, 2007 (436 days), P3 – the crisis period June 1, 2007 – February 27, 2009 (436 days), P4 – the post-crisis period March 2, 2009 – November 19, 2010 (436 days); S, M, B – the group of small, medium, big firms, respectively.

Source: Authors' own study.

Table 2. The shareholder structure of the companies with the highest ratio of the number of non-traded days to the total number of trading days in the period P1

Firm	Group	Non-tr.d.	Ratio	S.e.o.	Details of shareholder's structure
APL*	S	280	0.1119	29.07%	2 individual investors 29.07% (15.05% and 14.02%)
PMG	S	787	0.3145	92.09%	strategic entity (corporation TDJ S.A.) 92.09%; investment advisor 0.36%
BST	S	1443	0.5767	97.25%	2 individual investors 97.25% (82.29% and 14.96%)
GMM	M	308	0.1231	46.79%	1 institution (private equity) 46.79%; 1 strategic entity (corporation Grupa Gremi) 46.79%
MCL	M	414	0.1655	60.60%	4 investment advisors 18.10%; 4 individual investors 60.60%
BDZ	M	894	0.3573	61.35%	9 investors: 3 institutions 9.22% (2 investment advisors 4.70%; 1 pension fund 4.52%); 6 strategic entities 61.35% (3 corporations 24.62%; 2 individual investors 31.73%, government agency 5%)
WST	M	1386	0.5540	89.49%	2 individual investors 89.49% (81.49% and 8%)
BOS	B	415	0.1659	56.62%	20 investors 82.39% (19 institutions 25.77%; 10 investment advisors 7.13%; 9 pension fund 18.64%; 1 strategic entity – government agency 56.62%)
BNP**	B	1091	0.4361	100.00%	strategic entity 100% (corporation BNP Paribas S.A.)

Note: Firm – 3-letter abbreviation of the company's name; * – the company in arrangement bankruptcy since July 29, 2014; ** – the company with the last quotation on the WSE on May 15, 2015, currently: BGŻ BNP Paribas S.A.; S.e.o. – strategic entity ownership; other abbreviations: see Table 1.

Source: Authors' own study.

Obtained results indicate that there are 9 companies with the highest amount of non-traded days in the whole period analysed (P1), including 3 small, 4 medium and 2 big companies. Specific information regarding the shareholder structure of these companies is presented in Table 2.

The shareholder structure of the companies with the highest level of non-trading ratio, as indicated in Table 2, is diverse and does not seem to depend on the firm's size. In the case of two out of three small companies, the strategic entities are individual (private) investors, whereas in the case of the third small company the strategic entity is represented by a corporation. Similar situation can be observed in the group of companies of medium size. Both big companies summarized in Table 2 are banks and their ownership structures are also dissimilar. However, one can observe in Table 2 that the highest number of non-traded days seems to be connected with a high percentage level of strategic entity ownership. In the case of four firms with the highest number of non-traded days (i.e. PMG, BST, WST and BNP) strategic entity ownership is almost equal or even above ninety percent.

4. The frequency of non-trading in the context of firm size effects

In this section, we explicitly test the research hypothesis saying that the frequency of non-trading does not depend on the firm's size. To address this issue, all companies entered into the database (147) were sorted according to their market capitalization at the end of each year, beginning on December 31, 2004. The market capitalization MV was taken as the number of shares as of the end of the year multiplied by the end of the year WSE share price. In December of each year from 2004 to 2013, all stocks were ranked according to the size of MV. Next, the stocks were divided into three size-groups based on the breakpoints for the bottom 30% (SMALL – 44 companies), middle 40% (MEDIUM – 59 companies) and top 30% (BIG – 44 companies) (see, e.g.: [Fama, French 1993]). The companies that remained in the same group during the investigated period were selected. Finally, the 53 WSE companies were entered into separate, representative groups, specifically: 8 firms into the SMALL group, 18 firms into the MEDIUM group and 27 firms into the BIG group [Nowak, Olbryś 2015, p. 729]. To compare the results obtained, we investigate the whole sample period of January 2005 – December 2014 and three adjacent sub-periods of equal size: the pre-crisis, crisis, and post-crisis period.

The research hypothesis that the frequency of non-trading is not significantly larger for the small firms (the SMALL group), compared to the big (the BIG group) and medium companies (the MEDIUM group), is examined. A statistical test for the significance of the difference between two means among the groups of securities is employed. The following hypotheses are tested:

$$\begin{aligned} H_0 : \mu_1 &= \mu_2 \\ H_1 : \mu_1 &> \mu_2 \end{aligned}$$

where: μ_1 and μ_2 are the unknown expected values of the ratio in two groups of companies, and the null hypothesis states that two expected values are equal.

In case the population variances are equal, the test statistic t is used. In case the population variances turn out to be unequal, the t -Welch [Welch 1938, 1947] test statistic is employed. The results of the tests are reported in Table 3.

Table 3. Results of the test for the significance of the difference between two means of the ratio among the groups of securities

Period	Comparison	t	p-value	Result	Period	Comparison	t	p-value	Result
P1	S M	2.4029	0.0081	H_1	P1	S B	0.8653	0.1934	H_0
P2	S M	0.4623	0.3240	H_0	P2	S B	-0.3288	0.3711	H_0
P3	S M	-0.0399	0.4842	H_0	P3	S B	-0.3393	0.3672	H_0
P4	S M	1.0770	0.1407	H_0	P4	S B	-0.8520	0.1971	H_0

Note: For explanation of abbreviations, see Table 1.

Source: Authors' own study.

The obtained results indicate that there is no reason to reject the null hypothesis $H_0 : \mu_1 = \mu_2$ for almost all cases, except for the comparison between small and medium companies in the whole sample period P1.

5. Conclusion

The main goal of this paper was to document cross-time and cross-security patterns in non-trading among the WSE-listed stocks. To address this issue, we investigated the non-trading problem in the whole sample period of January 2005 – December 2014, and three adjacent sub-periods of equal size: the pre-crisis, crisis, and post-crisis period. The empirical results indicate no reason to reject the research hypothesis that the frequency of non-trading does not depend on the firm's size. Moreover, the results turned out to be rather robust to the choice of the sample. Finally, as a large number of the WSE-listed companies exhibit substantial non-trading, investors should recognize whether they have to take illiquidity risk into consideration in their financial decisions.

In general, our findings for the Polish emerging equity market seem to be in contrast to previous studies for the U.S. developed stock market. For example, Foerster and Keim [1993] found that the average amount of non-trading is larger for smaller firms and is directly related to the firm's size. The authors also revealed substantial heterogeneity in the amount of non-trading across the stocks.

While the non-trading findings are crucial in their own right, the evidence is useful for future research. One of the possible directions for further investigation would be to examine the relation between the non-trading frequency and portfolio

returns autocorrelation on the Warsaw Stock Exchange, following for example the methodology proposed by Chelley-Steeley and Steeley [2014]. The second direction could be a deep analysis of the relation between non-trading frequency and the shareholder structure of all the companies investigated, with regard to the changes in that structure over time.

References

- Atchison M., Butler K., Simonds R., 1987, *Nonsynchronous security trading and market index autocorrelation*, Journal of Finance, vol. 42, pp. 111-118.
- Bekaert G., Harvey C.R., Lundblad C., 2007, *Liquidity and expected returns: Lessons from emerging markets*, Review of Financial Studies, vol. 20, no. 6, pp. 1783-1831.
- Boudoukh J., Richardson M., Whitelaw R., 1994, *A tale of three schools: Insights on autocorrelations of short-horizon returns*, Review of Financial Studies, vol. 7, pp. 539-573.
- Brzeszczyński J., Gajdka J., Schabek T., 2011, *The role of stock size and trading intensity in the magnitude of the „interval effect” in beta estimation: Empirical evidence from the Polish capital market*, Emerging Markets Finance & Trade, vol. 47, no. 1, pp. 28-49.
- Campbell J.Y., Grossman S.J., Wang J., 1993, *Trading volume and serial correlation in stock returns*, The Quarterly Journal of Economics, vol. 108, no. 4, pp. 905-939.
- Campbell J.Y., Lo A.W., MacKinlay A.C., 1997, *The Econometrics of Financial Markets*, Princeton University Press, New Jersey.
- Chelley-Steeley P.L., Steeley J.M., 2014, *Portfolio size, non-trading frequency and portfolio return autocorrelation*, Journal of International Financial Markets, Institutions & Money, vol. 33, pp. 56-77.
- Cohen K.J., Hawawini G.A., Maier S.F., Schwartz R.A., Whitcomb D.K., 1980, *Implications of microstructure theory for empirical research on stock price behaviour*, Journal of Finance, vol. 35, pp. 249-257.
- De Jong F., Rindi B., 2009, *The Microstructure of Financial Markets*, Cambridge University Press, Cambridge.
- Dimson E., 1979, *Risk measurement when shares are subject to infrequent trading*, Journal of Financial Economics, vol. 7, pp. 197-226.
- Dimson E., Marsh P., 1983, *The stability of U.K. risk measures and the problem of thin trading*, Journal of Finance, vol. 38, pp. 753-783.
- Doman M., 2011, *Mikrostruktura giełd papierów wartościowych*, Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, Poznań.
- Fama E.F., 1970, *Efficient capital markets: A review of theory and empirical work*, Journal of Finance, vol. 15, pp. 383-417.
- Fama E.F., French K.R., 1993, *Common risk factors in the returns on stocks and bonds*, Journal of Financial Economics, vol. 33, no. 1, pp. 3-56.
- Fisher L., 1966, *Some new stock market indexes*, Journal of Business, vol. 39, pp. 191-225.
- Foerster S., Keim D., 1993, *Direct evidence of non-trading of NYSE and AMEX stocks*, Working Paper, University of Pennsylvania.
- Harris L., 2003, *Trading and Exchanges: Market Microstructure for Practitioners*, Oxford University Press.
- Hasbrouck J., 2007, *Empirical Market Microstructure*, Oxford University Press.
- Hawawini G.A., 1980, *The intertemporal cross price behavior of common stocks: Evidence and implications*, Journal of Financial Research, vol. 3, no. 2, pp. 153-167.

- Kadlec G.B., Patterson D.M., 1999, *A transactions data analysis of nonsynchronous trading*, The Review of Financial Studies, vol. 12, no. 3, pp. 609-630.
- Lo A.W., MacKinlay A.C., 1990, *An econometric analysis of nonsynchronous trading*, Journal of Econometrics, vol. 45, pp. 181-212.
- Mech T.S., 1993, *Portfolio return autocorrelation*, Journal of Financial Economics, vol. 34, pp. 307-344.
- Nowak S., 2014, *Order imbalance on the Warsaw Stock Exchange, 2000–2012*, International Conference Financial Investments and Insurance—Global Trends and Polish Market, Wrocław.
- Nowak S., Olbryś J., 2015, *Autokorelacja stóp zwrotu spółek giełdowych w kontekście zakłóceń w procesach transakcyjnych*, Zeszyty Naukowe Uniwersytetu Szczecińskiego No. 854. Finanse, Rynki Finansowe, Ubezpieczenia, no. 73, pp. 721-734.
- O'Hara M., 1998, *Market Microstructure Theory*, Blackwell Publishers, Cambridge.
- Olbryś J., 2011, *The intertemporal cross price behavior and the "Fisher Effect" on the Warsaw Stock Exchange*, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, Ekonometria, vol. 31, no. 194, pp. 153-163.
- Olbryś J., 2013a, *Price and volatility spillovers in the case of stock markets located in different time zones*, Emerging Markets Finance & Trade, vol. 49(S2), pp. 145-157.
- Olbryś J., 2013b, *Zastosowanie wybranych miar płynności aktywów kapitałowych na Gieldzie Papierów Wartościowych w Warszawie S.A.*, Zarządzanie i Finanse, vol. 11, no. 3, part 2, pp. 65-77.
- Olbryś J., 2014a, *Wycena aktywów kapitałowych na rynku z zakłóceniami w procesach transakcyjnych*, Wydawnictwo Difin S.A., Warszawa.
- Olbryś J., 2014b, *Efekt przedziałowy współczynnika determinacji modelu rynku*, Optimum. Studia Ekonomiczne, vol. 68, no. 2, pp. 75-84.
- Olbryś J., 2014c, *Is illiquidity risk priced? The case of the Polish medium-size emerging stock market*, Bank i Kredyt, vol. 45, no. 6, pp. 513-536.
- Olbryś J., Majewska E., 2014a, *Implications of market frictions: Serial correlations in indexes on the emerging stock markets in Central and Eastern Europe*, Operations Research and Decisions, vol. 24, no. 1, pp. 51-70.
- Olbryś J., Majewska E., 2014b, *Direct identification of crisis periods on the CEE stock markets: The influence of the 2007 U.S. subprime crisis*, Procedia Economics and Finance, vol. 14, pp. 461-470.
- Pagan A.R., Sossounov K.A., 2003, *A simple framework for analysing bull and bear markets*, Journal of Applied Econometrics, vol. 18, no. 1, p. 23-46.
- Perry P.R., 1985, *Portfolio serial correlation and nonsynchronous trading*, Journal of Financial and Quantitative Analysis, vol. 20, pp. 517-523.
- Scholes M., Williams J., 1977, *Estimating betas from nonsynchronous data*, Journal of Financial Economics, vol. 5, pp. 309-327.
- Schwert W., 1990, *Indexes of U.S. stock prices from 1802 to 1987*, Journal of Business, vol. 63, no. 3, pp. 399-426.
- Stoll H.R., 2000, *Friction*, Journal of Finance, vol. 55, no. 4, pp. 1479-1514.
- Tsay R.S., 2010, *Analysis of Financial Time Series*, John Wiley, New York.
- Welch B.L., 1938, *A significance of the difference between two means when the population variances are unequal*, Biometrika, vol. 29, no. 3/4, pp. 350-362.
- Welch B.L., 1947, *The generalization of 'Student's' problem when several different population variances are involved*, Biometrika, vol. 34, no. 1/2, pp. 28-35.