NATIONAL BANK OF POLAND
WORKING PAPER
No. 120

Large capital inflows and stock returns in a thin market

Janusz Brzeszczyński, Martin T. Bohl, Dobromił Serwa

Warsaw 2012

Acknowledgements: We would like to thank Ludwig Chincarini, Tim Vinaimont, Martha O'Hagan-Luff, David Cobham, Jacques Melitz, Mateusz Pipień, Mark Schaffer, the participants of the 86th Annual Conference of the Western Economic Association International (WEAI) in San Diego on June 29 – July 3, 2011, the 9th INFINITI Conference on International Finance at Trinity College in Dublin on June 13–14, 2011 and the participants of the research seminar at Heriot-Watt University for helpful comments on this and earlier versions of this paper. Dobromił Serwa thanks Piotr Szpunar, Marta Gołajewska and colleagues from the Financial System Department of the National Bank of Poland for advice and support.

Janusz Brzeszczyński (corresponding author) – Department of Accountancy, Economics and Finance, Heriot-Watt University, Edinburgh, United Kingdom, tel.: +441314513294; fax: +441314513296; e-mail: j.brzeszczynski@hw.ac.uk.
Martin T. Bohl – Westfälische Wilhelms University, Münster, Germany
Dobromił Serwa – National Bank of Poland, Warsaw, Poland and Warsaw School of Economics, Warsaw, Poland

Design:

Oliwka s.c.

Layout and print:

NBP Printshop

Published by:

National Bank of Poland
Education and Publishing Department
00-919 Warszawa, 11/21 Świętokrzyska Street
phone: +48 22 653 23 35, fax +48 22 653 13 21

ISSN 2084–624X

http://www.nbp.pl

CONTENTS

I. INTRODUCTION 3
II. STOCK MARKET AND PENSION SYSTEM REFORM IN POLAND 8
III. DATA AND METHODOLOGY 11
IV. EMPIRICAL RESULTS 17
V. COUNTERFACTUAL ANALYSIS AND TRADING STRATEGY OUT-OF-SAMPLE 24
VI. CONCLUSIONS 28
REFERENCES 29
TABLES AND FIGURES 32

ABSTRACT:

Using unique data about capital flows to private pension funds in Poland, we find that their impact, as a group of large institutional investors, on stock returns is statistically significant in short-term but no such effect exists in the long-run. We analyze the capital transfers, in form of the aggregated pension contributions collected from all employees in the entire Polish economy, from the public social security institute ZUS in Poland to the private pension funds, which further invest this capital on the stock market. The average time for the subsequent reaction of stock prices is found to be 4 days.

JEL: G23, G15

Keywords: Institutional Investors, Stock Market Returns, Pension Funds, Capital Flows.

I. INTRODUCTION

Large institutional investors, such as pension funds, which generate intensive capital flows are likely to have substantial impact on stock prices. This effect should, by nature, be more visible and more strongly pronounced in thinly traded markets, which are characterized by relatively low volume of transactions, low capitalization and low liquidity comparing with the amounts of capital being injected on regular basis by these large institutions.

On the other hand, it is known that the number of institutional investors trading on stock markets world-wide increased substantially in the past two decades, which has caused a gradually intensified interest among financial economists, practitioners as well as financial markets regulators in the issue of the impact of those institutions on stock prices. It is widely believed that institutional traders have direct influence on stock returns and the existing empirical evidence from international markets backs this conjecture, as reported by Kraus and Stoll (1972), Chan and Lakonishok (1993), Bikker, Spierdijk and van der Sluis (2007), Rakowski and Wang (2009) and recently Foster, Gallagher and Looi (2011) and references therein.[1]

The specific history of the Polish stock market provides a unique institutional feature and opportunity allowing us to contribute to the literature on the institutional investors' impact on stock prices, arising from the pension system reform in Poland in 1999, when privately managed pension funds (OFEs) were established and allowed to invest on the capital market. We study this impact and focus on the returns dynamics of the Warsaw Stock Exchange (WSE) blue chip stocks index WIG20 after the first transfer of money to the pension funds on May 19, 1999 until the end of 2008. The appearance of large institutional traders and the resulting increase in institutional ownership allows us to investigate the impact they have on stock returns. We distinguish between the effect of global factor from international markets and the local factor related to the institutional demand generated by the capital accumulated from the pension

[1] More evidence on institutions' trading behaviour, in particular their impact on volatility, autocorrelation and the issue of stabilization / destabilization of stock prices, can be found in earlier literature in, for example, Lakonishok, Shleifer and Vishny (1992), Grinblatt, Titman and Wermers (1995), Sias and Starks (1997), Nofsinger and Sias (1999), Wermers (1999), Dennis and Weston (2001), Sias, Starks and Titman (2001), Badrinath and Wahal (2002), Cohen, Gompers and Vuolteenaho (2002), Dennis and Strickland (2002) and Griffin, Harris and Topaloglu (2003), among others, and more recently in Schuppli and Bohl (2010).

contributions. Moreover, we also analyze the impact of ZUS transfers on the returns of the Polish market WIG20 index from the perspective of four frequencies of data: quarterly, monthly, weekly and daily in order to examine not only the effect of those capital flows on stock prices but also to investigate, more specifically, the pattern of propagation of their impact across time.

There exists evidence for the Polish market about the stabilizing effect of pension funds, as a group of large institutional investors, on stock prices volatility, provided in Bohl and Brzeszczynski (2006) and Bohl, Brzeszczynski and Wilfling (2009). There is, however, rather limited research and very little empirical evidence available on the direct impact of trades performed by institutional investors on stock market returns in emerging and thinly traded markets, except that reported in Zalewska (2006). We contribute to filling this niche by using unique data about actual transfers of capital from the pension institute (ZUS), collected centrally from all employees in Poland, to private pension funds, which invest it in the financial market.

Even though the previous studies on the role of pension funds, as a group of very large institutional investors, and the Polish market and are very limited and provide only scarce evidence about their impact on the movement of stock prices, this issue has been often discussed in popular business and financial press in Poland. For example, "Rzeczpospolita", a major Polish business and financial daily newspaper, reported that after the entrance of large pension funds the liquidity of the Polish market has become too low relative to the amounts of capital they managed and invested in stocks. There exists also anecdotal evidence in form of stories about stock market investors who have achieved very high returns by implementing a simple strategy relying on the analysis of transactions of large pension funds and predicting which stocks these institutional investors may favour in the future (Rzeczpospolita, 2002).

The problem of such high and regular capital flows, generated by large institutional investors, as well as, additionally, the limited liquidity of the Polish stock market provide a motivation for this study. The empirical results obtained in this investigation allow us to conclude about the direct impact of pension funds on the movement of stock prices at the WSE.

The existing literature related to this study and based on data from international markets presents different types of evidence about the impact of institutional trading on asset prices. Chan and Lakonishok (1993) analyzed the price impact of institutional trades using the data from 37 large money management firms from the years 1986 – 1988. They documented an immediate impact of transactions on stock price changes even after controlling for market-wide stock price

movements. International evidence on the impact of institutional trading on stock prices is provided also by Domowitz, Glen, and Madhavan (2001), and Chiyachantana, Jain, Jiang, and Wood (2004) among others.

Furthermore, Kraus and Stoll (1972) and Chan and Lakonishok (1993) document asymmetric effects between the price impact of buy and sell orders. Several studies found that buys have larger price impact than sells. Holthausen, Leftwich and Mayers (1987) argue that price effects are predominantly temporary for seller-initiated transactions and permanent for buyer-initiated transactions on the New York Stock Exchange. According to Keim and Madhavan (1996) the buyer-initiated transactions are more often information-based than sell transactions, which in turn are more often liquidity-motivated than buy transactions. While buys are driven by the preference to hold some specific stocks and therefore they may set new higher values for their prices, the liquidity-driven sells do not change the prices, at least not permanently. Saar (2001) developed the theoretical model, where the history of price performance of stocks affects the degree of asymmetry between the price impact of buys and sells. Longer bull market periods decrease the asymmetry, or even reverse it, and longer episodes of price depreciation increase the asymmetry.

Chiyachantana, Jain, Jiang, and Wood (2004) investigated the price effects of institutional trading in international stocks from 37 countries in the period from 1997 to 2001 and found that the asymmetry of the price impact depends on market conditions: buys have a larger effect on prices during bull market periods and the impact of sells is stronger during bear market periods. Chiyachantana, Jain, Jiang, and Wood (2004) argue that it is easy to sell a stock in a bull market, when many traders are willing to buy. Similarly, it is easy to find a seller of a stock in a bear market. Bikker, Spierdijk, and van der Sluis (2007) analyzed the impact of traders by ABP, the largest Dutch pension fund, and found that price effects of buy transactions (sell transactions) tend to be larger than those of sells (buys) in bull (bear) markets. The overall price effects are also moderate in comparison to similar effects studied earlier for other types of institutions. Bikker, Spierdijk, and van der Sluis (2007) explain this result by the fact that the analyzed ABP trades are generally rebalancing activities, not coinciding with news-driven trades and therefore they cause less price impact. Dasgupta, Prat and Verardo (2011) developed a theoretical model to analyze the impact of institutional herding on asset prices. They fond that institutional trades in

the presence of herding positively predict short-term returns, but negatively predict long-term returns.

It is worthwhile to note that Polish market has particular characteristics of the emerging stock market, which make it different from other, well developed and mature, stock markets. In particular, what has happened in Poland was the *reversal of roles of individual and institutional investors* after the pension system reform in Poland in 1999, i.e. the informational role of the institutions relative to individuals was principally different before and after the year 1999.[2]

In Poland until the end of the 1990s, the individual investors (private people) constituted the majority of the stock market investors and generated most of the trading volume. This was due to certain legal regulations not allowing such institutional investors as pension fund to invest in stocks and to the fact that the whole capital market itself was at the very early stage of its development and some institutions (like the pension funds or other types of investment funds) simply did not exist. The individual investors, who dominated the market, were just ordinary people who (sometimes very naively) followed the news, newspaper articles, various information in other media (very often not professional sources, having little to do with the financial markets) as well as the rumours – and therefore they, as a whole group, exhibited herding behavior. After 1999 the pension funds entering the market played the role of informed traders relative to the individuals. Some evidence confirming the impact of institutional trading on stock prices is the decrease in stock returns volatility after the entrance of pension funds on the market in Poland, as reported in Bohl and Brzeszczynski (2006) and Bohl, Brzeszczynski and Wilfling (2009).

In this paper we provide more evidence about the role of a group of large institutional investors (i.e. private pension funds) on the stock market prices, in particular when their impact is viewed from the perspective of various time horizons, such as quarterly, monthly, weekly and daily. Zalewska (2006) analyzed the long-run effects of the pension reform in 1999 and found that the Polish stock market was performing worse than other emerging markets in the region afterwards. However, Zalewska (2006) did not investigate capital flows to the market, as we do

[2] Sias, Starks and Titman (2001) provide the evidence that it is the "informed trading" that moves prices and it is institutional investors (not individuals) who are more likely to be informed than other investors (see also Dennis and Weston, 2001; and Kamesaka, Nofsinger and Kawakita, 2003). If this is the case, then the entrance of pension funds in Poland in 1999 could, indeed, affect the behaviour of stock prices.

in this study, and could not assess their direct impact on stock prices in the short-run or in the long-run.

The remainder of the paper is organized as follows. Section II contains a description of the pension system reform and its consequences for the investors' structure in the stock market in Poland. Section III discusses the data and methodology. Section IV presents empirical findings. Section V summarizes and concludes.

II. STOCK MARKET AND PENSION SYSTEM REFORM IN POLAND

Polish Stock Market and Investors' Structure

Re-established in 1991, the Polish stock market has grown rapidly during the last two decades in terms of the number of listed companies and market capitalization. The capitalization of Warsaw Stock Exchange (WSE) is comparable to the smaller, mature European markets, like the Austrian or the Greek stock markets, and equals currently about 45 bn US dollars.

The present investors' structure on the Polish stock market has its origin in the pension system reform in the year 1999, when the public system was enriched by a private component, represented by open-end pension funds. Participation in this component, often called the "second pillar", is mandatory for employees below certain age. Employees are obliged to transfer 7.3% of their gross salary to the government-run social insurance institute called Zakład Ubezpieczeń Społecznych (ZUS), which in turn transfers the collected contributions to the private pension funds OFEs. The first transfer of money from the ZUS to the pension funds took place on May 19, 1999. This date marks a significant change of the investors' structure in the Polish stock market. In 1999, about 20% of the domestic institutional investors and 45% of the domestic individual investors traded at the Warsaw Stock Exchange. This situation has nearly reversed and the number of institutional traders approximately doubled after 1999 (e.g., Warsaw Stock Exchange, 2011). Constantly about 35% of the investors on the Polish stock market adhere to the group of foreign investors.

While before May 19, 1999 the majority of traders were small, private investors, after that date pension funds became important players on the stock market in Poland. There were also some mutual funds active in the market but they had relatively small amounts of capital under management. Moreover, the role of corporate investors, i.e. companies investing their capital surpluses, was very marginal.

The number of pension funds in Poland over the analyzed period of time varied. The change in their numbers occurred mainly due to the mergers and acquisitions of the smaller funds by the larger ones. It is important to note, however, that their structure as well as the structure of the assets under their management remains rather invariant. Right after the start of pension system reform in 1999 the share of pension funds investments in stocks was relatively very low, typically in the range of 3% - 10% of their total assets, but it soon increased to 30% in 2000 and stayed consistently at that level in the subsequent years. For example, in the snapshot at

the end of 2003, 16 pension funds operated in Poland with 11.8 bn US dollars under management. In comparison, Polish insurance companies and mutual funds had only 3 and 1 bn US dollars of assets, respectively. The pension funds invested about 3.8 bn US dollars in stocks listed on the Warsaw Stock Exchange in that year. At the end of 2009 the total portfolio of these pension funds was almost six fold larger: 62.8 bn US dollars including the 18.7 bn US dollars invested in shares on the Warsaw Stock Exchange.

The share of pension funds in the Warsaw Stock Exchange turnover reached its maximum level in the years 2002 and 2003, i.e. 13.6% and 10.1% of average daily turnover, respectively. Taking into account only the free floating stocks, this share was even larger, 21.7% and 23.2%, respectively. In the next years, the share of pension funds in the Warsaw Stock Exchange turnover has been steadily decreasing and has fluctuated around the 5% level since 2006. More importantly, the share in the turnover of free floating stocks has had a positive trend and reached the level of 30.4% in 2009, as reported by National Bank of Poland (2004; 2011).

The stock holdings of pension funds predominantly consist of large capitalization stocks that are listed in the blue-chip index WIG20 and usually belong to the largest ones in their industries. Therefore, pension funds have emerged as important players on the Polish stock market with the amounts of capital capable to affect stock prices.

Origins and Implementation of the Pension System Reform

Through the entire 1990s all the consecutive governments in Poland, regardless of the political orientation, were aware of the necessity of pension system reform and they openly articulated it. It has been becoming increasingly apparent that the old pension system, inherited from the centrally planned economy overthrown in 1989, was going to bankrupt, as evidenced by, for example, Superintendency of Pension Funds (2000, 6-13).

As a result of the pensions reform in the year 1999, the “three pillars” system has been introduced, where the first pillar is a state pension (paid to every citizen, however in very small amounts), the second pillar are the private pension funds OFEs (with compulsory participation for people below certain age) and the third pillar are other private investment funds (with voluntary participation).

Despite the political discussions, the new system started to operate in May 1999. New pension funds received a lot of media attention and positive publicity right from the start in 1999

(e.g. Rzeczpospolita, 1999), however the implementation of the reform raised new concern connected with the concentration of capital in the pension funds industry and the stock market liquidity. First, since the start of the reform the number of funds has been decreasing because of mergers and acquisitions. In consequence, more of the fresh capital has been accumulating in a smaller number of pension funds. Second, the pension funds - forced by law to invest mainly in the domestic market – jointly gained significant control in the public companies quoted at the Warsaw Stock Exchange. In some cases the cumulated share of all pension funds in a single company exceeded 25%. Taking into account a limited number of stocks at the Warsaw Stock Exchange and a small number of new issues on the one hand and the rapidly growing mass of capital in the pension funds on the other hand, this trend was likely to be continued.

The problem of limited liquidity of the Polish stock market after the new pension funds started their investments and have been accumulating increasingly higher amounts of capital from employees' pension contributions has been reported by major Polish business and financial newspapers and magazines (e.g. Rzeczpospolita, 2002).[3] The issue of too strong concentration of pension funds industry creating the risk of damaging the competition between them has also been often discussed in popular business and financial press in Poland already after the start of the pension system reform (e.g. Rzeczpospolita, 2001).

[3] At the start of the reform in the late 1999s this situation may have had following two serious implications for stock market in Poland: (1) pension funds could collectively execute their rights as shareholders in the public companies by appointing members of supervisory boards, thus gaining more control over these firms and possibly causing such threats as manipulation of the information from the companies (and manipulation of their prices at the stock exchange) and (2) pension funds could have too strong impact on the stock market because the amount of capital they had under management was too high and gave them power to move prices in the market characterized by relatively low liquidity. One of the possibilities this effect might have is triggering volatility and destabilizing stock market (however evidence about the opposite effect of an impact of institutional investors in Poland on stock prices volatility was presented in, e.g., Bohl and Brzeszczynski, 2006, and Bohl, Brzeszczynski and Wilfling, 2009).

III. DATA AND METHODOLOGY

Data

In this investigation we use unique database composed of very detailed data about the transfers from the public pension funds institute Zakład Ubezpieczeń Społecznych (ZUS) in Poland (Social Security Institute) to the private pension funds OFEs, which invest this capital on the stock market and on other financial markets. The data was obtained directly from the ZUS.

We also use the data about the prices and returns of the blue-chip stock index of the Warsaw Stock Exchange (WSE) – the WIG20 index – and the Dow Jones Industrial Average (DJIA) index from the New York Stock Exchange (NYSE). The latter is assumed to represent the movements of the global stock market and is used as a control variable that allows us to extract the effect of the local factor (capital from ZUS invested in stocks at the Warsaw Stock Exchange) comparing with the effect of the influence of the global market volatility. The source of the WIG20 and DJIA data is Datastream.

The important characteristic of capital transfers from the ZUS to the OFE pension funds as the main explanatory variable in our models is that it does not directly depend on any other variable used in this investigation. It depends rather on the general economic situation, liquidity needs and technical procedures in the Polish social security institute ZUS, and also on some macroeconomic (or even demographic) factors, such as the number of employed and retired persons, the total value of wages and the government fiscal policies in the country. The transfers from ZUS obviously affect the value of pension funds' investments on the stock market, but the transfers themselves are independent of the global and local financial market conditions in contrast to the investments of pension funds. Therefore, our proposed variable acts as a natural tool to analyze the impact of capital investments on stock returns.

The data from ZUS about the transfers to private pension funds spans over the period from May 1999 to December 2008 and covers a total of 1,098 individual observations. All transfers are expressed in local currency (Polish zloty, PLN), similarly to WIG20 returns.

This data sample provides unique laboratory-like conditions not only because it allows to analyze directly the impact of transfers from ZUS to the pension funds on the stock prices, but also because during this period of time the market was completely dominated by domestic pension funds while foreign pension funds started to invest in Poland only later (*Parkiet*, 2010). Hence, in this study we can extract the effect of the impact of pension funds investments as a

homogenous group of investors and analyze their impact on stock prices without the influence of foreign pension funds as a different type of institutional investors.

ZUS transfers variable is trending upwards over time, which is most likely caused by such factors as: increasing wages (both in nominal and real terms), rising number of employees in the real economy (which overall results in the increasing pension contributions) and the inflation. In order to avoid obvious problems resulting from the use of a trending variable in our models, we de-trend it by dividing the transfers for all data frequencies by their respective moving averages, which allows us to analyze the long-run impact of pension funds investments on stock prices. Hence, the variable which we use as ZUS transfers, denoted as *TRANSbyMA*, can be interpreted as relative (percentage) deviation of ZUS capital transfers from the long-run trend.

As an additional control variable we exploit the WIG20 volume of trade, which we also de-trend using the same technique (deviations from the moving average) as in case of the ZUS transfers.

Modeling strategy

We investigate first the long-term effects of pension funds investments in the stock market in Poland and construct the models for quarterly and monthly frequency of data. Then we turn our attention to the short-term effects and analyze the models for weekly and daily data frequencies. Such modeling strategy allows us to compare the impact of the ZUS transfers on the stock prices from various perspectives and in different time-horizons.

There exists broader evidence about the impact of capital flows on stock returns in the long-run - as documented by, for example, Bekaert, Harvey and Lumsdaine (2002), Goyal (2004) and Lou (2011) - and we investigate whether the flows generated by investments of the group of large institutional investors in Poland, i.e. the private pension funds, have similar effects in the longer term but also in shorter time periods.

Models for quarterly, monthly, weekly and daily data were constructed using the variables aggregated to their respective frequencies of observation. Additionally, we created the variables that span over the period of 2-, 3- and 4-days to investigate the effects of the ZUS capital flows on stock prices in the intervals longer than 1 day but shorter than 1 week.

The quarterly / monthly / weekly / daily returns for the WIG20 and DJIA indices were computed using the values of those two indices at the end of every quarter / month / week / day (and similarly so for 2-, 3- and 4-days long intervals). The value of individual ZUS transfers has been added within every quarter / month / week etc. and divided by respective moving averages to create the de-trended transfers variable: *TRANSbyMA*. The same technique has been adopted for the WIG20 volume of trade, which has been aggregated in a similar way and allowed us to create the de-trended volume variable: *VOLbyMA*.

For the quarterly data we calculated the deviations of transfers and volume from their moving averages from the previous 4 quarters of the year. Due to the fact that the transfers at the very beginning of the period in the first year in the sample (i.e. year 1999, starting in May 1999) were significantly lower than later, we did not use this period for the measurement of the de-trended transfers (or any other variable) and we started our estimation period for all models in the year 2001. The first de-trended transfer (*TRANSbyMA*) and de-trended volume (*VOLbyMA*) was calculated for Q1 2001 (using data from four previous quarters from Q1 2000 to Q4 2000). Similarly, we used the first 12 months of the year 2000 to calculate the moving average for the de-trended transfers and the de-trended volume for the monthly data. For the weekly and daily data we divided the transfers by their 12-week (3-month) moving averages and the 60-day (3-month) moving averages, respectively. Therefore, we were able to start our estimation sample with daily and weekly data already in the second quarter of the year 2000 and we set the end of the sample at December 31, 2008.

The variables for a respective data frequency are denoted using letters "*q*" (for quarterly), "*m*" (for monthly), "*w*" (for weekly), "*d*" (for daily) and "*2d*", "*3d*" and "*4d*" (for multiple day long intervals) at the end of every variable's name. Hence, for example, the de-trended quarterly transfers from the ZUS pensions institute to the private pension funds are denoted as: $TRANSbyMAq_t$ and the de-trended transfers for the monthly frequency are denoted as: $TRANSbyMAm_t$. Similarly, the names of variables for quarterly (monthly) de-trended volume of trade are: $VOLbyMAq_t$ ($VOLbyMAm_t$) and for the quarterly (monthly) stock index returns: r_t^{WIG20q} and r_t^{DJIAq} (r_t^{WIG20m} and r_t^{DJIAm}). The same system has been used to create names of all other variables for other data frequencies.

The variability of ZUS transfers and the WIG20 index is clearly different during bull and bear market periods, so in order to be able to extract the effects of ZUS transfers on the WIG20 index in those two distinct market phases we estimated variants of models using those segmented sub-samples, which allowed us to assess the impact of transfers during the time when the markets are characterized by a general rise or general fall of stock prices and also provides robustness check of the results.

In our sample of 8 calendar years 2001 - 2008, the bull market covers the period: Q2 2003 – Q2 2007 for the quarterly data and April 2003 – June 2007 for the monthly data while the bear market period covers: Q1 2001 – Q3 2001 and Q3 2001 – Q4 2008 for the quarterly data and January 2001 – September 2001 and July 2007 – December 2008 for the monthly data. For the weekly and daily models the cut-off dates are analogous to those from the monthly data.

Any possible conditional heteroscedasticity of residuals in empirical versions of all the models was tested using the Engle's (1982) LM multiplier test and it is subsequently eliminated using appropriate GARCH specifications. Autocorrelation, if it existed, was eliminated by the imposition of AR and/or MA terms.

Modeling long-run and short-run effects of pension funds investments

We estimated the following models for the returns of the WIG20 index for all analyzed frequencies of data:

$$r_t^{WIG20i} = \alpha + \beta \cdot TRANSbyMAi_t + \delta \cdot r_t^{DJIAi} + \gamma \cdot VOLbyMAi_t + \xi_t \qquad (1)$$

where: $i = q, m, w, 4d, 3d, 2d, d$ and $q = quarterly,\ m = monthly,\ w = weekly$ frequency and $4d = 4day,\ 3d = 3day,\ 2d = 2day$ and $d = 1day$ denote the frequencies for intervals of 4, 3, 2 and 1 day length. The returns of the WIG20 and DJIA indices are denoted as: r_t^{WIG20i} and r_t^{DJIAi}, respectively, and the de-trended ZUS transfers and the de-trended volume of trade of the WIG20 index volume as: $TRANSbyMAi_t$ and $VOLbyMAi_t$, for various intervals and data frequencies *i* as defined and explained above. The ξ_t is an error term.

In addition, we extended our analysis by checking specifications of models with lags of transfers, volume and the DJIA returns and also segmented the entire sample into the sub-samples covering bull and bear market periods.

The impact of capital injection from ZUS into the stock market is expected to be more pronounced when higher frequency data rather than low frequency data is used for analysis. Such an impact can be interpreted as evidence that the effects of pension fund investment on the stock market are short-lived in nature and that they are most likely a market microstructure phenomenon rather than the long-run tendency affecting the development of the market. For example, Zalewska (2006) suggests that the introduction of the pension fund investments on the WSE stock exchange in 1999 did not improve the long-run performance of the Polish stock market in relation to other competing markets in the region. According to the market microstructure theory the changes in stock prices are related to the mechanism of selling and buying stocks. In line with this concept, the increased supply of capital (and greater demand for stocks) usually increases the volume of long (buying) positions relative to short (selling) positions on the market and moves the prices up.[4]

Therefore, we pay particular attention to the analysis of short-run impact of OFE investments on stock prices and we use a range of high frequencies of data, such as daily, 2-day, 3-day, and 4-day long intervals as well as weekly changes in WIG20 and other variables. The use of different short-term frequencies is motivated by the fact that the observed transfers of capital from the ZUS (and subsequently from the OFEs) are not likely to be immediately invested in stocks (e.g. on the same day when the ZUS transfer to the OFE pension funds has taken place) and such process may, in fact, require a number of days. The investment may be postponed by the internal decision process in individual OFE pension funds, overall principles of their specific investment strategies (e.g. gradual investment of large amounts of capital, such as "stealth trading" techniques) or other technical barriers. In our analysis, the lagged variables are used to control for the delayed impact of transfers, while the multi-day frequencies of data control for gradual capital investment strategies (over a number of days).

[4] Another possible channel for the ZUS transfers to affect stock prices could be through the macroeconomic information contained in the amounts of capital invested on the stock exchange and the timing of investments. For example, weaker economic conditions in the household sector could limit the capital available at ZUS and subsequently reduce capital transfers from ZUS through the OFE pension funds into financial markets.

We employ the opening prices of the DJIA index to construct a proxy for the returns from the world market, i.e. the following return of the DJIA: $r_t^{DJIA} = \log(DJIA_t^{open}) - \log(DJIA_{t-1}^{open})$. We use similar definitions for 2-day, 3-day, 4-day and weekly returns of the DJIA index.

In the daily and multi-daily models the transfers $ZUSbyMAd_t$ (and the respective variables in the multi-day models, i.e.: $ZUSbyMA2d_t$, $ZUSbyMA3d_t$ and $ZUSbyMA4d_t$) have been also lagged to test and check the robustness of the delay effects between the actual transfer and the time during which the capital from ZUS is invested on the stock market. We investigate each model in the full sample, in the bull periods and in the bear periods.

IV. EMPIRICAL RESULTS

Results of the long-run analysis

Table 1 presents the estimates of quarterly and monthly models for the returns of the WIG20 index r_t^{WIG20q} with the de-trended ZUS transfers ($TRANSbyMAq_t$) as well as the control variables: returns of the DJIA index (r_t^{DJIAq}) and the de-trended volume of trade ($VOLbyMAq_t$). The correlation between $TRANSbyMAq_t$ and $VOLbyMAq_t$ in the whole sample is only 0.04, so there is no problem with multicollinearity if those two variables are introduced simultaneously in one equation.

The first important finding in Table 1 is that in the entire sample of data (specifications of models from s1 to s4) all estimates of the r_t^{DJIAq} are positive and significant (at the p=0.01 level) while the estimates of the transfers $TRANSbyMAq_t$ are not significant in any specification of any model (with or without the control variables), which clearly demonstrates the dominance of the global factor represented by the DJIA index and no evidence of impact of the ZUS transfers when the entire period of analysis is taken into account.

The estimation results paint a similar picture, when the whole period is disaggregated into bull and bear market phases (specifications of models from s5 to s8 and from s9 to s12). In both bull and bear market sub-samples the estimates of r_t^{DJIAq} are positive and in all cases but one they are significant, which confirms very strong impact of the DJIA index in both periods of bull and bear market phases, however there is evidence of a stronger relationship in the bear rather than bull market as indicated by higher values of parameter estimates. It suggests that the WIG20 is more strongly influenced by the DJIA index during the bear market, which provides evidence of tighter linkages between Polish stock market and the US market (which represents here the global factor) and possibly also a stronger contagion effect related to the times of the financial crises.

By segmenting the sample into sub-samples of bull and bear market phases, we can also extract the effect of ZUS transfers on the WIG20 index returns when the markets are in an upward or downward trend. The results in Table 1 demonstrate, however, that the estimates of the parameters for the de-trended transfers $TRANSbyMAq_t$ in either the bull or in the bear market periods are not statistically significant in the quarterly models, so they do not have any impact on stock prices in such long horizon in any of those two distinct sub-periods.

Summarizing, we can conclude that there is no evidence about the impact of the ZUS transfers in the quarterly models due to the lack of significance of the estimates of the $TRANSbyMAq_t$ variable (and any of its lags either) in the entire period and in the sub-samples of bull and bear market phases.[5]

Table 1 presents also the estimates of monthly models for the returns of the WIG20 index r_t^{WIG20m} with the ZUS transfers ($ZUSbyMAm_t$) as explanatory variable and monthly returns of the DJIA index (r_t^{DJIAm}) as well as the WIG20 volume of trade ($VOLbyMAm_t$) as a control variables.

The findings from monthly frequency data are very similar to the results from quarterly models, where the DJIA index is the main driving force for the WIG20 index returns. The bottom panel in Table 1 shows that all estimates of r_t^{DJIAm} are positive and significant at the p =0.01 level for the whole sample and in both sub-samples, but higher estimates have been observed in the bull market than in the bear market period.

In summary, the evidence from quarterly and monthly models clearly indicates that there is no relationship between ZUS transfers and the subsequent stock price changes in the long run. Capital flows do not significantly affect long-term returns, because the Polish financial market is efficient enough to adjust prices in response to non-informative (liquidity) trades within just a few days. Moreover, the flows from the ZUS to pension funds are not sufficiently strongly correlated with the general macroeconomic conditions to be able to affect asset prices. Finally, possible effects could not be distinguished either from other types of important economic information that may have impact on asset prices. However, it cannot be excluded that they may exists in shorter horizons and can be identified using models built for higher frequency data. We investigate such short term effects in the next section.

Results of the short-run analysis

In the next step we analyze the impact of ZUS transfers over much shorter horizons: i.e. over the weekly and daily time intervals.

[5] The analysis of the goodness of fit measure R^2 also reveals that the ZUS transfers have a poor power in explaining the returns of the WIG20 index for the quarterly and monthly data (but not in higher frequency models presented and discussed in the next section).

Table 2 presents first the estimation results for the weekly frequency models. The return from the US market (r_t^{DJIAw}) is again the most significant explanatory variable in all specifications. There is also a statistically significant immediate impact of the trading volume ($VOLbyMAw_t$) on the WIG20 returns r_t^{WIG20w}.

The most important finding in Table 2 from the point of view of the main objective of this study is the positive and statistically significant estimate of the ZUS capital transfers variable ($TRANSbyMAw_t$) on the WIG20 returns. It means that there exists an impact of ZUS funds being injected by the OFE pension funds into the stock market. Moreover, it persists only within one week's space of time since the lagged weekly transfer variables are not statistically significant (estimates for further lags than *t-1* are not reported in Table 2 but are available upon request). The positive relationship between capital transfers and WIG20 returns is statistically significant in the full sample (but usually not significant in the shorter bull and bear periods, however the parameter values remain consistently always positive there). We also investigated results from our models in three-yearly sub-samples (constructed as a moving window) and found that the transfers from ZUS are positively related to WIG20 returns in all of those sub-periods, although the estimated impact is not statistically significant in some of them. These periods can not be linked directly to bear or bull market phases.

It is important to emphasize that the evidence about the short-run impact of transfers on stock prices in the weekly models is robust to adding control variables, as indicated by the results in the subsequent columns in Table 2.

Given this robust finding about the impact of ZUS transfers on stock prices within the period of one week's time reported and discussed above, we further investigate shorter intervals and higher data frequencies to provide more robustness checks and to see additionally if this effect can be identified more precisely over a certain number of days within a week. In other words, we extend our analysis in order to find out how quickly (in terms of the number of days) the impact of ZUS capital injected into the stock market is materialized after the transfer of capital from ZUS to the OFE pension funds takes place and whether this effect is a gradual process (e.g. due to gradual investments of capital or possibly because investors interpret news and react to them with a lag) or rather a more rapid phenomenon. If the latter is the case, it should be possible to identify such impact on a specific day (e.g. first or second or third or fourth day etc.) after the transfer from ZUS is completed by employing lagged transfers as explanatory

variables. In turn, analyzing different frequencies of data will help in identifying whether the impact is gradual in nature and if it is spread over some longer time.[6] This investigation, hence, allows to answer the question what is the degree of the delay between the transfer of capital from ZUS to the OFE private pension funds and the length of time the OFEs need, on average, to invest those funds on the stock market.

Below we discuss estimation results from models where variables are based on data using the 4-, 3-, 2 and 1-day long intervals. The parameter estimates from those models are presented in further panels in Table 2.

The results from models using 4-day long intervals for the construction of all variables indicate that in the full sample the impact of ZUS transfers on the stock prices is even stronger than in the weekly models – both in terms of the statistical significance (the *p*-values are at the 0.01 level rather than 0.05 or 0.1 levels as in case of the previous, weekly frequency, models' estimates) and in terms of the magnitude of the estimated parameter (e.g. 0.0031 versus 0.0048 in specifications s3 and similarly so in other specifications in Table 2) which is higher by about 50% in the 4-day interval models in comparison with the weekly ones. This is a very important finding, which shows that the impact of ZUS transfers is stronger within 4 rather than within 5 days long (i.e. weekly) intervals and it means that the OFE pension funds usually invest the capital received from the ZUS in the periods of *up to* 4 days. This result is also confirmed below by estimates from higher frequency models, in particular the daily ones, with their respective lags.

Table 2 illustrates also that the impact of the ZUS transfers is stronger during bull periods than during bear periods in all specifications, but the values of the relevant parameters are positive in every case in both sub-samples. This result confirms the findings from earlier studies on the impact of institutional trades on asset prices that the effects of buy transactions are stronger in bull periods, because it is easier to buy stocks when others are selling than when others are also buying and moving the prices up. Buys are also driven by the preference to hold

[6] Gradual investment of large amounts of capital by large institutional investors, such as the OFE pension funds in Poland, which is divided into many transactions that are spread over a number of days, would be consistent with the "stealth trading" effects known in the financial markets whereas the traders do not want to signal to the market that they intend to buy or sell large quantities of stocks, so they execute their transactions using smaller portions of capital and spread them gradually over a longer interval of time, e.g. a week rather than a day.

some specific stocks and therefore they may set new higher and permanent values for these stocks.

In the full sample, the impact of the ZUS capital transfer lagged by one period is significant and negative, but the cumulated impact remains positive in all cases. We additionally investigated sub-samples of 200 observations (constructed as a moving window) and found a significant positive impact of capital transfers on WIG20 during the second half of the full sample rather than during the first half of that sample. This result points to the increasing impact of trades by pension funds on stock prices, which is in line with the increasing share of pension funds in the turnover of free floating stocks.

The estimates from models using 3-day long intervals for construction of all variables presented in Table 2 show, generally, that the impact of capital transfers is not statistically significant in most specifications (however the estimates are mostly positive yet not as consistently so as in the previous models). Some results from bull and bear sub-samples indicate a negative instantaneous link between capital flows and WIG20 returns, but the cumulative impact, taking into account lagged variables, is positive. Analyzing again the sub-samples of 200 observations (as a moving window), we find a positive impact in most of the sub-periods with the exception only of the first 200-observations long window. We also find that this impact becomes the most significant at the end of our entire 8-year sample.

Similar results are obtained from the models estimated for the 2-day long intervals. They do not allow us to identify any robust evidence on the impact of the ZUS capital flows on the Polish stock market in this particular interval of time. The instantaneous impact is usually positive in the full sample and in the bull sub-sample, but it is not statistically significant in almost all of the reported specifications. Moreover, the aggregated lagged impact is negative in the full sample and in the bear market sample. Analyzing again the moving windows of 200 observations, we find the aggregated (instantaneous and lagged) impact of capital flows to be positive in most cases.

Finally, the last panel in Table 2, which presents estimation results from daily frequency models, provides more evidence about the length of delay between the ZUS transfers and the reaction of stock prices. The estimates show that in the whole sample there is no statistically significant impact of the ZUS capital flows on day t, which is the day on which the transfers from the ZUS to the OFE pension funds take place (however, the respective parameter estimates

from all model specifications are positive). Hence, the result that the ZUS transfers lose significance within the periods of time shorter than 4 days, as already observed in the models for 3- and 2-day intervals in other panels in Table 2, is confirmed also here using the daily models.

The lags in all other higher frequency models tend to confirm the above effect as well.[7] The estimates for lags in the models in full sample in the bottom panel of Table 2 in the specification s4 with all controlling variables are positive for all first 3 lags (*t-1*, *t-2* and *t-3*) and the estimate is statistically significant (at the 0.1 level) only for the lag *t-3*. This means that up to the day *t-3* the impact of ZUS transfers on stock prices is positive and the strongest effect is detected for lag *t-3*. However, this positive effect completely disappears already in lag *t-4*, which is consistent with findings in Table 2 presented in panels for the weekly and for the 4-day long intervals and corresponds exactly with the estimates for weekly (i.e. 5-day intervals) and 4-days intervals models (c.f. the respective specifications in Table 2), where the strongest impact was observed for 4-day intervals rather than for the 5-day intervals, i.e. rather than within the entire week (this is because the lag *t-4* is the one which is included in the weekly interval but not in the 4-day interval, which covers only days: *t*, *t-1*, *t-2* and *t-3*).

Moreover, this lagged effect is confirmed also by the estimates of lags in 3-day intervals (showing no statistical significance of any lags) and the 2-day intervals models. The obtained estimation results provide evidence that for day *t* no statistically significant effect exists (only except for the specification s4 in the full sample, where the estimate gains significance but only at the weak $p = 0.1$ level), however the lag *t-1* is significant (at the stronger $p = 0.05$ level) and also positive (note that the lag *t-1* in the 2-day interval models covers the lags *t-2* and *t-3* in the daily models). The estimate of the *t-2* lag is negative and significant at the $p = 0.05$ level (again, lag *t-2* in the 2-day interval models covers the lags *t-4* and *t-5* from the daily models), which is fully consistent with the negative and also statistically significant estimate for lag *t-4* in daily models.[8]

[7] Note that the respective intervals on which the construction of all variables is based (i.e. the returns of both stock market indices WIG20 and DJIA as well as the aggregated ZUS capital flows and the aggregated volume of trade) cover the following days: the weekly intervals (i.e. 5-day intervals) cover days *t*, *t-1*, *t-2*, *t-3* and *t-4*; the 4-day intervals cover days *t*, *t-1*, *t-2* and *t-3*; the 3-day intervals cover days *t*, *t-1* and *t-2*; the 2-day intervals cover days *t* and *t-1*; and, finally, the daily intervals cover only the day *t*.

[8] The negative and statistically significant estimate for the lag *t-4* in the daily models, as well as the findings for the weekly and 4-day interval models, might additionally suggest that there exists some *correction mechanism* in stock

The results discussed above, in conjunction with the findings reported already in Table 1 and previous panels in Table 2, suggest that the impact of the injection of the ZUS capital into the stock market is spread over longer time of approximately 4-5 days after the transfer from the ZUS to the OFEs takes place and it is most strongly marked within the first 4 days. In consequence, we can conclude that it is quite likely that the large institutional investors, i.e. the OFE pension funds in Poland, engage in the "stealth trading" investment strategies when buying stocks.[9]

The findings from the short-run analysis for the full sample suggest that the main effects of capital transfers from the ZUS to the OFE pension funds, and subsequently to the stock market, are most significant during the first week after the transfer takes place. In the shorter sub-periods there is more evidence on the positive impact of capital flows during the bull market than the bear market and towards the end of the sample.

Finally, the results from short-run analysis, using the models built for the daily frequency data, reveal an interesting finding which allows us to asses quite precisely the scale of the delay, and even estimate the average length of time, between the transfer of capital from ZUS to the OFE pension funds in Poland and its further investment in the stock market. It appears from our models that this delay is contained within the 4 day long period of time (i.e. from day *t-3* until day *t*, while on day *t-4* this effect already disappears), which is consistent with the "stealth trading" hypothesis of stock market investors. This is a new result which sheds more light and provides more evidence about the trading habits of large institutional investors, such as large pension funds trading in a relatively small and thin market, which has not been reported in the literature before.

---

prices after the period of 4 days of constant injection of the new capital from the ZUS by the OFE pension funds into the stock market (i.e. beyond the space of time between days *t-3* and *t*).

[9] As a further robustness check, we also normalized the variable *ZUS* containing the nominal values of capital transfers from the ZUS to the OFE pension funds by dividing it by its 60-day sample standard deviation. We did that because the volatility of the variable *TRANSbyMA*, used in our investigations, shows some downward trend for some higher frequencies of data, namely daily, 2-day and 3-day long intervals. We found a positive and often significant impact (instantaneous and lagged) of the de-trended transfers on the WIG20 returns for daily and for the 2-day interval models. The results for the 3-day interval models were similar to those obtained and explained above using the variable *TRANSbyMA*. Detailed results are available upon request.

V. COUNTERFACTUAL ANALYSIS AND TRADING STRATEGY OUT-OF-SAMPLE

In this section we present two different types of robustness analysis for our results obtained in the in-sample period from 1999 to 2008: (1) counterfactual analysis for the period *before* the pension system reform and *before* the entrance of the OFE pension funds in 1999 and (2) performance of trading strategy based on the findings from the in-sample period, simulated out-of-sample in the period *after* 2008, i.e. from 2009 to 2011 (3 years).

Since there is no data available about transfers from ZUS to the OFE private pension funds for the period preceding the reform, the only possibility to conduct a counterfactual analysis in case of this study is to exploit the pattern of transfers observed in the in-sample period (after the pension system reform when ZUS started to transfer first funds) and use it for the simulation of investment results in the period before the reform. Hence, we calculated the frequency of the ZUS transfers in the period between 1999 and 2008 and noticed that the transfers after the reform were taking place mostly at the beginning and at the end of each calendar month. There were five days in an average month, between the 14th and the 18th day of each month, when transfers were about 27% less frequent than on other days and the daily amounts transferred equaled on average only 22% of the daily amounts transferred on other days (cf. Figures 1 and 2), meaning nearly 80% less capital being transferred by ZUS on those days.

Next we compared results from investments only on the days in the middle of each month and on the other days every month. We did calculations of returns for the three sub-periods: pre-reform subsample (from January 1, 1998 to April 30, 1999), after-reform sub-sample in which we did estimations of all models (from May 1, 1999 to December 31, 2008) and out-of-sample period (from January 1, 2009 to December 31, 2011). The results are presented in Table 3. It shows that the investments on the days when on average larger and more frequent transfers to OFEs took place (after the reform) resulted in positive returns, while the investments on the days with less frequent transfers were characterized by negative returns. In contrast, the investments in the middle of the month in the sample before the reform (following the "low-transfers strategy") returned on average positive profits and the investments on other days (following the "large-transfers strategy") led to negative returns. These findings show that the introduction of OFEs and their investments on the Warsaw Stock Exchange fuelled by the funds transferred from ZUS to the OFEs could lead to construction of simple and profitable investment strategies that were not possible to execute in the earlier period (before the pension system reform).

Finally, we checked if the results from the in-sample estimation hold out-of-sample and we investigated in more details the effects of the Polish pension reform on investment strategies in the Warsaw stock market in the out-of-sample period in years 2009 - 2011. The estimation results from the in-sample period (in Tables 1 and 2) indicate that the stock prices react most strongly to the capital flows from ZUS to the OFEs during the first 4 days after the funds are transferred, i.e. between days *t* and *t+3*, so we simulated an investment strategy which relies on this finding and where a hypothetical stock market investor buys the WIG20 index at the end of the day preceding the day when each transfer was made and holds the position open for the next 4 days.

Table 4 presents results for such strategy as well as for the benchmark buy-and-hold strategy in the whole period of years 2009 – 2011 and in the sub-periods of bull and bear market phases. The strategy is presented in two different variants: for all ZUS transfers regardless of their size (Strategy 1) and only for large transfers when a transaction is made depending on the value of the capital flows measured by the deviation from their moving average and filtered using the threshold of 1, i.e. when the transfer is larger than its moving average from the last 3 months, it is considered as large and only then the investment is made (Strategy 2). Returns in Strategy 1 and 2 are calculated as compounded returns after each transaction.

The results in Table 4 show that in the whole period both strategies would have performed better than the benchmark, i.e. than a simple buy-and-hold strategy. Strategy 1 based on all transfers made 21.57% profit and Strategy 2 based on only large transfers achieved even better result of 26.30%, while the buy-and-hold strategy returned 19.82% in the same period of time. In the bull market sub-period both strategies achieved positive returns but they performed worse than the benchmark, which is mainly due to a relatively short investment period and smaller number of trades, in particular for Strategy 2 after filtering out the trades based on the transfers smaller than the their moving average (the investment periods for the buy-and-hold strategy, Strategy 1 and Strategy 2 equal 555, 350 and 160 days, respectively). However, in the bear market sub-period, both Strategy 1 and Strategy 2 performed better than the benchmark, which decreased by -45.39%, while the strategies based on the ZUS flows recorded much less negative returns (i.e. -27.30% and -20.81%). This finding shows that large capital flows in form of larger amounts of capital transferred from the ZUS to OFEs create additional demand and help to counteract the price falls in the bear markets.

We further investigate the performance of both strategies based on the ZUS capital flows in the out-of-sample period by using the most important risk-adjusted measures, such as the modified Sharpe ratio of Israelsen (2005) and the Certainty Equivalent returns (see e.g. DeMiguel et al., 2009), which we computed for Strategy 1 and Strategy 2 as well as for the benchmark buy-and-hold strategy (i.e. for the WIG20 index). The Sharpe ratio measures excess return per unit of risk, however the classical definition of the Sharpe ratio suffers from inaccuracy errors and incorrect assessment of risk when returns are negative in some sub-periods, so we calculated the modified Sharpe ratio (*MSR*) of Israelsen (2005):

$$MSR = ER/SD^{(ER/absER)} \tag{2}$$

where *ER* is the excess return defined as mean monthly difference between the strategy (or index) return and the risk-free return computed for the number of trades in our strategies (or number of trading days for the index in the whole out-of-sample period), and *SD* is the corresponding sample standard deviation of the differences of returns. The risk-free rate for the Polish market which we used was the return of the 3-month Treasury Bill obtained from the National Bank of Poland. *MSR* is a commonly used measure to deal with the problem of negative returns and alleviates the problems with the traditional Sharpe ratio.

Certainty Equivalent (*CEQ*) returns are defined as:

$$CEQ = \hat{\mu}_k - (\gamma/2)\hat{\sigma}_k^2 \tag{3}$$

where $\hat{\mu}_k$ and $\hat{\sigma}_k^2$ are the mean and variance of excess returns of the strategy or an index k and γ is the risk aversion parameter. As in case of the modified Sharpe ratio (*MSR*), the risk-free rate was the return of the 3-month Treasury Bill obtained from the National Bank of Poland. The formulation of *CEQ* in (2) assumes a multi-period investor with quadratic utility. The ‚normal' level of risk aversion is γ=1, while higher (lower) values of γ indicate higher (lower) levels of risk aversion.

Results in Table 4 clearly show that both strategies have achieved better values of modified Sharpe ratio in the whole period. In particular Strategy 2 has the *MSR* value over 2

times higher than the buy-and-hold strategy (0.0359 *versus* 0.0158). In the bull market sub-period the *MSR* values are very similar, which demonstrates that the adjustment for risk has reduced the differences between the buy-and-hold strategy and the strategies based on the ZUS flows which were evident in the raw returns. In the bear market period the outperformance of Strategy 1 and strategy 2 relative to the buy-and-hold strategy is even stronger, which indicates usefulness of the information about the transfers of capital from the ZUS to the OFEs private pension funds for the stock market investors in such adverse market conditions.

The values of Certainty Equivalent (*CEQ*) returns are presented in Table 4 for five variants representing normal risk aversion of investors (γ=1), lower risk aversion (γ=0.5, i.e. half of normal risk aversion level) and higher risk aversion levels (γ=2, i.e. double the normal risk aversion level, as well as γ=5 and γ=10) and they paint a similar picture as the *MSR* measures: Strategies 1 and 2 have achieved clearly better results than the buy-and-hold strategy in the whole sample as well as in the bear market sub-period. In addition, Strategy 2, based on large capital transfers, has outperformed the buy-and-hold strategy also in the bull market period for γ=10.

VI. CONCLUSIONS

Using unique database about transfers of large amounts of capital from the public social security institute ZUS in Poland to the private pension funds OFEs, which further invest it on the stock market, we investigated the impact of large institutional investors on stock prices.

Our findings indicate that in the longer horizon, for monthly and quarterly data, the global factor in form of the returns of the DJIA index returns dominates over local capital flows from the ZUS and explains better the returns of the WIG20 index than the ZUS transfers. This suggests that capital flows to pension funds, possibly associated with present economic developments in the country, have a negligible long-run impact on stock prices.

In short horizon, however, for the weekly and daily data, the transfers of capital from ZUS to private pension funds are related to the subsequent changes of the WIG20 index. From the market microstructure perspective, this effect may be explained by the price impact of capital flows to the stock market.

We also present unique evidence about the length of time between the ZUS transfers of capital and its subsequent investment by the OFEs private pension funds on the stock market, which sheds light on the nature of trading of those large institutional investors. We find that the OFE pension funds investments affect stock prices only during the first week after the transfers of capital from ZUS, most notably within the first 4 days after the transfers took place, which can be interpreted as the amount of time required by the OFEs to the invest the capital, which they receive from the ZUS, on the stock market. This result is consistent with the "stealth trading" hypothesis but the identified delay effect is contained within a relatively small number of days.

Our findings provide new evidence about the impact of pension funds as a group of large institutional investors on stock returns on a relatively thinly traded market and may have direct and very practical implications for the investment strategies of other stock market participants. They also provide useful knowledge for financial markets regulators whose aim is to supervise stock markets and understand the nature of impact of trading by large institutional investors on stock prices and on market volatility.

REFERENCES

Badrinath, S. G., and S. Wahal. "Momentum Trading by Institutions." *Journal of Finance*, 57(6), 2002, 2449–2478.

Bekaert, G., C. R. Harvey, and R. L. Lumsdaine. "The Dynamics of Emerging Market Equity Flows." *Journal of International Money and Finance*, 21(3), 2002, 295–350.

Bikker, J. A., L. Spierdijk, and P. J. van der Sluis. "Market impact costs of institutional equity trades." *Journal of International Money and Finance*, 26(6), 2007, 974–1000.

Bohl, M.T., and J. Brzeszczynski. "Do Institutional Investors Destabilize Stock Prices? Evidence from an Emerging Market." *Journal of International Financial Markets, Institutions and Money*, 16(4), 2006, 370–383.

Bohl, M.T., J. Brzeszczynski, and B. Wilfling. "Institutional Investors and Stock Returns Volatility: Empirical Evidence from a Natural Experiment." *Journal of Financial Stability*, 5(2), 2009, 170–182.

Chan, L. K. C., and J. Lakonishok. "Institutional Trades and Intraday Stock Price Behaviour." *Journal of Financial Economics*, 33(2), 1993, 173–199.

Chiyachantana, C. N., P. K. Jain, C. Jiang, and R. A. Wood. "International Evidence on Institutional Trading Behaviour and Price Impact." *Journal of Finance*, 59(2), 2004, 869–898.

Cohen, R. B., P. A. Gompers, and T. Vuolteenaho. "Who Underreacts to Cash-Flow News? Evidence from Trading between Individuals and Institutions." *Journal of Financial Economics*, 66(2), 2002, 409–462.

Dasgupta, A., A. Prat, and M. Verdado. "Institutional Trade Persistence and Long-Term Equity Returns." *Journal of Finance*, 66(2), 2011, 635–653.

DeMiguel, V., L. Garlappi, and R. Uppal. "Optimal Versus Naive Diversification: How Inefficient Is the 1/N Portfolio Strategy?" *Review of Financial Studies*, 22(5), 2009, 1915-1953.

Dennis, P. J., and D. Strickland. "Who Blinks in Volatile Markets, Individuals or Institutions?" *Journal of Finance*, 57(5), 2002, 1923–1950.

Dennis, P. J., and J. P. Weston. "Who's Informed? An Analysis of Stock Ownership and Informed Trading." working paper, University of Virginia, 2001.

Domowitz, I., J. Glen, and A. Madhavan. "Liquidity, Volatility and Equity Trading Costs across Countries and over Time." *International Finance*, 4(2), 2001, 221–255.

Engle, R.F. "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation." *Econometrica*, 50(4), 1982, 987–1007.

Foster, F. D., D. R. Gallagher, and A. Looi. "Institutional Trading and Share Returns." *Journal of Banking and Finance*, 25(12), 2011, 3383–3399.

Goyal, A. "Demographics, Stock Market Flows and Stock Returns." *Journal of Financial and Quantitative Analysis*, 39(1), 2004, 115–142.

Griffin, J. M., J. H. Harris, and S. Topaloglu. "The Dynamics of Institutional and Individual Trading." *Journal of Finance*, 58(6), 2003, 2285–2320.

Grinblatt, M., S. Titman, and R. Wermers. "Momentum Investment Strategies, Portfolio Performance, and Herding: A Study on Mutual Fund Behavior." *American Economic Review*, 85(5), 1995, 1088–1105.

Holthausen, R. W., R. W. Leftwich, and D. Mayers. "The Effect of Large Block Transactions on Security Prices: A Cross-Sectional Analysis", *Journal of Financial Economics*, 19(2), 1987, 237–268.

Israelsen, C.L. "A Refinement to the Sharpe Ratio and Information Ratio." *Journal of Asset Management*, 5(6), 2005, 423-427.

Kamesaka, A., J. Nofsinger, and H. Kawakita. "Investment Patterns and Performance of Investor Groups in Japan." *Pacific Basin Finance Journal*, 11(1), 2003, 1–22.

Keim, D. B., and A. Madhavan. "The Upstairs Market for Large-Block Transactions: Analysis and Measurement of Price Effects." *Review of Financial Studies*, 9(1), 1996, 1–36.

Kraus, A., and H. R. Stoll. "Price Impacts of Block Trading on the New York Stock Exchange", *Journal of Finance*, 27(3), 1972, 569–588.

Lakonishok, J., A. Shleifer, and R. W. Vishny. "The Impact of Institutional Trading on Stock Prices", *Journal of Financial Economics*, 32(1), 1992, 23–43.

Lou, D. "A Flow-Based Explanation for Return Predictability", working paper, London School of Economics, 2011.

National Bank of Poland. "Financial System Development in Poland 2002–2003." Warsaw, 2004.

National Bank of Poland. "Rozwój Systemu Finansowego w Polsce w 2009 roku." Warsaw, 2011.

Nofsinger, J. R., and R. W. Sias. "Herding and Feedback Trading by Institutional and Individual Investors." *Journal of Finance*, 54(6), 1999, 2263–2295.

Parkiet. "Norweski Państwowy Fundusz ma Więcej Akcji Polskich Firm." 6th March 2010.

Rakowski, D., and X. Wang. "The Dynamics of Short-term Mutual Fund Flows and Returns: A Time-series and Cross-sectional investigation." *Journal of Banking and Finance*, 33(11), 2009, 2102–2109.

Rzeczpospolita. "Coraz Bliżej do Startu. Rejestracja w Sądzie Funduszy." 2nd February 1999.

Rzeczpospolita. "Czy Można Zrezygnować z Reformy? Korzyści Iluzoryczne, Straty Pewne." 13th September 2001.

Rzeczpospolita. "Giełda Coraz Płytsza Nawet dla OFE." 11th January 2002.

Saar, G. "Price Impact Asymmetry of Block Trades: An Institutional Trading Explanation." *Review of Financial Studies*, 14(4), 2001, 1153–1181.

Schuppli, M., and M. T. Bohl. “Do Foreign Institutional Investors Destabilize China’s A-share Markets.” *Journal of International Financial Markets, Institutions and Money*, 20(1), 2010, 36–50.

Sias, R. W., and L. T. Starks. “Return Autocorrelation and Institutional Investors.” *Journal of Financial Economics* 46(1), 1997, 103–131.

Sias, R. W., L. T. Starks, and S. Titman (2001), “The Price Impact of Institutional Trading”, working paper, University of Arizona, 2001.

Superintendency of Pension Funds. “Security Through Competition. Performance Analysis of the Second Pillar.” Warsaw, 2000.

Warsaw Stock Exchange. “Investors and Exchange Trading in 2010. Survey Summary.” Warsaw, 2011.

Wermers, R. “Mutual Fund Herding and the Impact on Stock Prices.” *Journal of Finance*, 54(2), 1999, 581–622.

Zalewska, A. “Is Locking Domestic Funds into the Local Market Beneficial? Evidence from the Polish Pension Reforms.” *Emerging Markets Review*, 7(4), 2006, 339–360.

TABLE 1

Estimates of parameters from the models for long-run relationships (for quarterly and monthly frequency of data).

	Full sample				**Bull market periods**				**Bear market periods**			
	Quarterly models											
	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12
const.	0.1362 (0.2579)	0.1135 (0.1527)	0.0604 (0.2001)	0.3802 (0.3282)	0.1601 (0.1010)	0.1425 (0.1053)	0.0162 (0.1768)	0.1576 (0.4896)	0.1250 (0.5308)	0.2276 (0.3226)	0.2014 (0.3592)	0.1054 (0.4327)
$TRANSbyMA_q$	-0.1236 (0.2468)	-0.0987 (0.1481)	-0.0984 (0.1613)	-0.1552 (0.2095)	-0.0792 (0.0923)	-0.0753 (0.0929)	-0.0396 (0.1322)	0.0554 (0.1604)	-0.2431 (0.4921)	-0.2905 (0.3047)	-0.2252 (0.4175)	0.1257 (0.2450)
$TRANSbyMA_{q-1}$				-0.1926 (1.1680)				-0.0942 (0.2812)				-0.1545 (0.2984)
r_t^{DJIAq}		1.1646*** (0.1273)	1.1406*** (0.1477)	1.1680*** (0.1490)		0.4218* (0.2060)	0.3796* (0.2006)	0.5341** (0.2267)		0.8239*** (0.2017)	0.7872** (0.2697)	0.9276 (0.2635)
r_{t-1}^{DJIAq}				0.2495 (0.1779)				0.4943 (0.4234)				0.1673 (0.2728)
$VOLbyMA_q$			0.0465 (0.0658)	0.0333 (0.0660)			0.0766 (0.0577)	0.0512 (0.0411)			-0.0403 (0.1545)	-0.0151 (0.1549)
$VOLbyMA_{q-1}$				-0.0402 (0.0738)				-0.1104* (0.0513)				-0.0989 (0.0945)
	Monthly models											
	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12
const.	-0.0025 (0.0206)	-0.0013 (0.0164)	-0.0414 (0.0279)	-0.0077 (0.0429)	0.0290 (0.0234)	0.0114 (0.0198)	-0.0319 (0.0310)	-0.0426 (0.0566)	-0.0567 (0.0497)	0.0129 (0.0371)	0.0500 (0.0445)	0.2592** (0.1001)
$TRANSbyMA_m$	0.0050 (0.0187)	0.0053 (0.0149)	0.0041 (0.0147)	-0.0014 (0.0166)	-0.0025 (0.0195)	0.0022 (0.0157)	0.0025 (0.0155)	0.0098 (0.0188)	0.0112 (0.0488)	-0.0321 (0.0374)	-0.0194 (0.0369)	-0.0619 (0.0392)
$TRANSbyMA_{m-1}$				-0.0043 (0.0177)				0.0098 (0.0232)				-0.0888* (0.0437)
r_t^{DJIAm}		1.1380*** (0.1334)	1.1082*** (0.1443)	1.1466*** (0.1498)		1.1993*** (0.2722)	1.1221*** (0.2743)	1.2281*** (0.3048)		1.0989*** (0.1807)	1.0261*** (0.1608)	1.0618*** (0.1812)
r_{t-1}^{DJIAm}				-0.1087 (0.1275)				-0.2117 (0.2545)				-0.1511 (0.2235)
$VOLbyMA_m$			0.0354 (0.0235)	0.0495* (0.0293)			0.0356 (0.0269)	0.0379 (0.0363)			-0.0453 (0.0298)	-0.0737* (-0.0409)
$VOLbyMA_{m-1}$				-0.0342 (0.0248)				-0.0062 (0.0307)				-0.0353 (0.0342)

Notes:

a) Robust standard errors of parameter estimates are presented in parentheses. Highlighted cells indicate statistical significance, which is denoted as: *** significant at 0.01 level, ** significant at 0.05 level and * significant at 0.1 level.

b) Bull and bear market periods are defined as follows:

Quarterly models - bull market: Q2 2003 – Q2 2007 and bear market: Q1 201 – Q3 2001 and Q3 2001 – Q4 2008

Monthly models - bull market: April 2003 – June 2007 and bear market: January 2001 – September 2001 and July 2007 – December 2008.

TABLE 2
Estimates of parameters from the models for short-run relationships (for weekly and daily frequency of data).

	Full sample				**Bull market periods**				**Bear market periods**			
	Weekly models											
	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12
const.	-0.0011 (0.0022)	-0.0016 (0.0018)	-0.012*** (0.0039)	-0.0062 (0.0052)	0.0035 (0.0029)	0.0019 (0.0025)	-0.0045 (0.0046)	0.0009 (0.0062)	-0.014*** (0.0042)	-0.0098** (0.0041)	-0.022*** (0.0085)	-0.0237** (0.0108)
$TRANSbyMA_w$	0.0028* (0.0016)	0.0028** (0.0013)	0.0031** (0.0014)	0.0034** (0.0015)	0.0021 (0.0021)	0.0020 (0.0018)	0.0022 (0.0019)	0.0022 (0.0019)	0.0061** (0.0029)	0.0032 (0.0025)	0.0034 (0.0025)	0.0041 (0.0027)
$TRANSbyMA_{w-1}$				-0.0013 (0.0014)				-0.0010 (0.0018)				-0.0019 (0.0025)
r_t^{DJIAw}		0.6132*** (0.1277)	0.6047*** (0.1412)	0.6502*** (0.0984)		0.7943*** (0.1206)	0.7782*** (0.1211)	0.7753*** (0.1154)		0.5381*** (0.1502)	0.5605*** (0.1548)	0.6117*** (0.1211)
r_{t-1}^{DJIAw}				0.1266 (0.1076)				0.0179 (0.1192)				0.1530 (0.1085)
$VOLbyMA_w$			0.0092*** (0.0032)	0.0106*** (0.0037)			0.0058 (0.0036)	0.0074* (0.0041)			0.0119* (0.0068)	0.0123* (0.0074)
$VOLbyMA_{w-1}$				-0.0057 (0.0039)				-0.0060 (0.0041)				0.0025 (0.0075)
	4-daily models											
	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12
const.	-0.0013 (0.0017)	-0.0017 (0.0015)	-0.0090** (0.0035)	-0.0007 (0.0044)	0.0021 (0.0021)	0.0012 (0.0019)	-0.0036 (0.0041)	0.0049 (0.0050)	-0.010*** (0.0038)	-0.0072** (0.0031)	-0.0120* (0.0072)	-0.0108 (0.0088)
$TRANSbyMA4d_t$	0.0049** (0.0019)	0.0045*** (0.0017)	0.0048*** (0.0017)	0.0053*** (0.0017)	0.0051** (0.0025)	0.0044* (0.0024)	0.0046* (0.0024)	0.0043* (0.0025)	0.0062 (0.0042)	0.0030 (0.0037)	0.0031 (0.0038)	0.0041 (0.0037)
$TRANSbyMA4d_{t-1}$				-0.0031* (0.0018)				-0.0017 (0.0027)				-0.0026 (0.0036)
r_t^{DJIA4d}		0.5680*** (0.0694)	0.5569*** (0.0687)	0.5832*** (0.0544)		0.6302*** (0.1122)	0.6115*** (0.1131)	0.6038*** (0.1157)		0.7166*** (0.0957)	0.7200*** (0.0944)	0.7623*** (0.1004)
r_{t-1}^{DJIA4d}				0.2261*** (0.0490)				0.1056 (0.0976)				0.1848** (0.0740)
$VOLbyMA4d_t$			0.0068** (0.0032)	0.0097*** (0.0037)			0.0044 (0.0035)	0.0072 (0.0044)			0.0045 (0.0060)	0.0054 (0.0064)
$VOLbyMA4d_{t-1}$				-0.009*** (0.0030)				-0.010*** (0.0036)				-0.0004 (0.0068)
	3-daily models											
	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12
const.	0.0001 (0.0012)	0.0002 (0.0011)	-0.0058** (0.0023)	-0.0024 (0.0027)	0.0031** (0.0014)	0.0027** (0.0013)	-0.0002 (0.0025)	0.0030 (0.0032)	-0.0065** (0.0026)	-0.0049* (0.0026)	-0.0002 (0.0025)	-0.0094 (0.0068)
$TRANSbyMA3d_t$	0.0016* (0.0009)	0.0012 (0.0009)	0.0014 (0.0009)	0.0013 (0.0009)	0.0003 (0.0014)	-0.0002 (0.0014)	-0.0001 (0.0014)	0.0000 (0.0014)	0.0029 (0.0019)	0.0020 (0.0019)	-0.0001 (0.0014)	0.0022 (0.0018)
$TRANSbyMA3d_{t-1}$				0.0000 (0.0010)				0.0012 (0.0015)				0.0002 (0.0017)
r_t^{DJIA3d}		0.5207*** (0.0533)	0.5112*** (0.0531)	0.5125*** (0.0515)		0.6594*** (0.0993)	0.6533*** (0.0996)	0.6428*** (0.0995)		0.5765*** (0.0874)	0.6533*** (0.0996)	0.5932*** (0.0846)
r_{t-1}^{DJIA3d}				0.1162** (0.0498)				0.0615 (0.0899)				0.0730 (0.1048)
$VOLbyMA3d_t$			0.0056** (0.0022)	0.0077*** (0.0025)			0.0027 (0.0023)	0.0061** (0.0027)			0.0027 (0.0023)	0.0009 (0.0052)
$VOLbyMA3d_{t-1}$				-0.0055** (0.0022)				-0.007*** (0.0028)				0.0035 (0.0045)

Table 2. (continued)

	Full sample				Bull market periods				Bear market periods			
	2-daily models											
	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12
const.	0.0003 (0.0007)	0.0001 (0.0007)	-0.004*** (0.0013)	0.0001 (0.0019)	0.0017** (0.0009)	0.0013 (0.0009)	-0.0026* (0.0014)	-0.0002 (0.0023)	-0.0037** (0.0015)	-0.0027* (0.0014)	-0.0059** (0.0029)	-0.0048 (0.0043)
$TRANSbyMA2d_t$	0.0006 (0.0006)	0.0007 (0.0006)	0.0007 (0.0006)	0.0011* (0.0006)	0.0013 (0.0009)	0.0014 (0.0009)	0.0014 (0.0009)	0.0023** (0.0011)	0.0003 (0.0013)	-0.0002 (0.0012)	-0.0001 (0.0012)	0.0003 (0.0011)
$TRANSbyMA2d_{t-1}$ and further lags				lags: +**,-***, -*				lags: +***, -***,-				lags: -,-,-
r_t^{DJIA2d}		0.4589*** (0.0428)	0.4559*** (0.0429)	0.4548*** (0.0419)		0.5080*** (0.0795)	0.4975*** (0.0810)	0.4580*** (0.0775)		0.5161*** (0.0676)	0.5219*** (0.0680)	0.5276*** (0.0662)
r_{t-1}^{DJIA2d} and further lags				lags: +***,+ ,+				lags: +**,-,-				lags: +,+,+
$VOLbyMA2d_t$			0.0041*** (0.0012)	0.0057*** (0.0013)			0.0037*** (0.0012)	0.0060*** (0.0014)			0.0030 (0.0027)	0.0022 (0.0030)
$VOLbyMA2d_{t-1}$ and further lags				lags: -**,-**, +				lags: -**,-***,+**				lags: +,+,-
	Daily models											
	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12
const.	0.0004 (0.0003)	0.0003 (0.0003)	-0.002*** (0.0007)	0.0003 (0.0009)	0.0010*** (0.0004)	0.0009** (0.0004)	-0.0010 (0.0008)	0.0014 (0.0010)	-0.0016** (0.0007)	-0.0013** (0.0007)	-0.0031** (0.0014)	-0.0038** (0.0019)
$TRANSbyMAd_t$	0.0003 (0.0003)	0.0003 (0.0003)	0.0003 (0.0003)	0.0003 (0.0003)	0.0011** (0.0005)	0.0010* (0.0005)	0.0009* (0.0005)	0.0009 (0.0005)	0.0002 (0.0005)	0.0000 (0.0005)	0.0000 (0.0005)	0.0002 (0.0005)
$TRANSbyMAd_{t-1}$ and further lags				lags: +,+,+*,-*				lags: +*,+***, -,-***				lags: -,-,+,-
r_t^{DJIAd}		0.2906*** (0.0301)	0.2851*** (0.0300)	0.2868*** (0.0297)		0.3005*** (0.0500)	0.2935*** (0.0505)	0.3092*** (0.0490)		0.3584*** (0.0510)	0.3593*** (0.0512)	0.3625*** (0.0512)
r_{t-1}^{DJIAd} and further lags				lags: +,+***,+,+				lags: +,+***,-,-				lags: -,+,+,+
$VOLbyMAd_t$			0.0022*** (0.0006)	0.0027*** (0.0008)			0.0018** (0.0007)	0.0026*** (0.0009)			0.0017 (0.0013)	0.0013 (0.0015)
$VOLbyMAd_{t-1}$ and further lags				lags: -,-,-*,-				lags: -,-,-***,-				lags: -,+, -**,+**

Notes:

a) Robust standard errors of parameter estimates are presented in parentheses. Highlighted cells indicate statistical significance, which is denoted as: *** significant at 0.01 level, ** significant at 0.05 level and * significant at 0.1 level.

b) Bull and bear market periods are defined as follows:
bull market: April 2003 – June 2007 and bear market: January 2001 – September 2001 and July 2007 – December 2008.

c) In the bottom two panels presenting estimates for daily and 2-daily models, for the parameters of lagged variables only the signs of individual parameters and their significance levels are reported and denoted with asterisks next to the sign of the respective estimate.

Table 3. Results from investments on days in the middle of each month and on other days of each month.

Returns from investments:	In the middle of each month:	On other days of each month:
Pre-reform sub-sample January 1, 1998 to April 30, 1999	11.97%	-12.55%
After-reform sub-sample (in-sample estimation period) May 1, 1999 to December 31, 2008	-24.49%	43.64%
After-reform sub-sample (out-of-sample period) January 1, 2009 to December 31, 2011	-30.95%	49.03%

Table 4. Results of trading strategies in the out-of-sample period (years 2009-2011).

Strategy:	Number of trades:	Return:	Modified Sharpe ratio:	Certainty Equivalent (CEQ) measure:				
				$\gamma = 0.5$	$\gamma = 1$	$\gamma = 2$	$\gamma = 5$	$\gamma = 10$
Whole sample:								
Simple buy-and-hold	1	19.82%	0.0158	0.0197%	0.0123%	-0.0025%	-0.0470%	-0.1212%
Strategy 1 (based on all ZUS transfers)	108	21.57%	0.0206	0.0229%	0.0185%	0.0097%	-0.0168%	-0.0609%
Strategy 2 (based on only large ZUS transfers)	50	26.30%	0.0359	0.0295%	0.0276%	0.0238%	0.0122%	-0.0070%
Bull market sub-sample:								
Simple buy-and-hold	1	119.22%	0.0897	0.1380%	0.1315%	0.1186%	0.0797%	0.0148%
Strategy 1 (based on all ZUS transfers)	81	67.24%	0.0734	0.0896%	0.0855%	0.0774%	0.0530%	0.0123%
Strategy 2 (based on only large ZUS transfers)	39	59.50%	0.0961	0.0828%	0.0808%	0.0770%	0.0653%	0.0459%
Bear market sub-sample:								
Simple buy-and-hold	2	-45.39%	-0.5740	-0.3018%	-0.3114%	-0.3307%	-0.3887%	-0.4852%
Strategy 1 (based on all ZUS transfers)	28	-27.30%	-0.2221	-0.1584%	-0.1637%	-0.1742%	-0.2058%	-0.2583%
Strategy 2 (based on only large ZUS transfers)	12	-20.81%	-0.0967	-0.1153%	-0.1171%	-0.1207%	-0.1316%	-0.1498%

Figure 1. Value of transfers of funds from the ZUS on specific days of the month between 1999 and 2011.

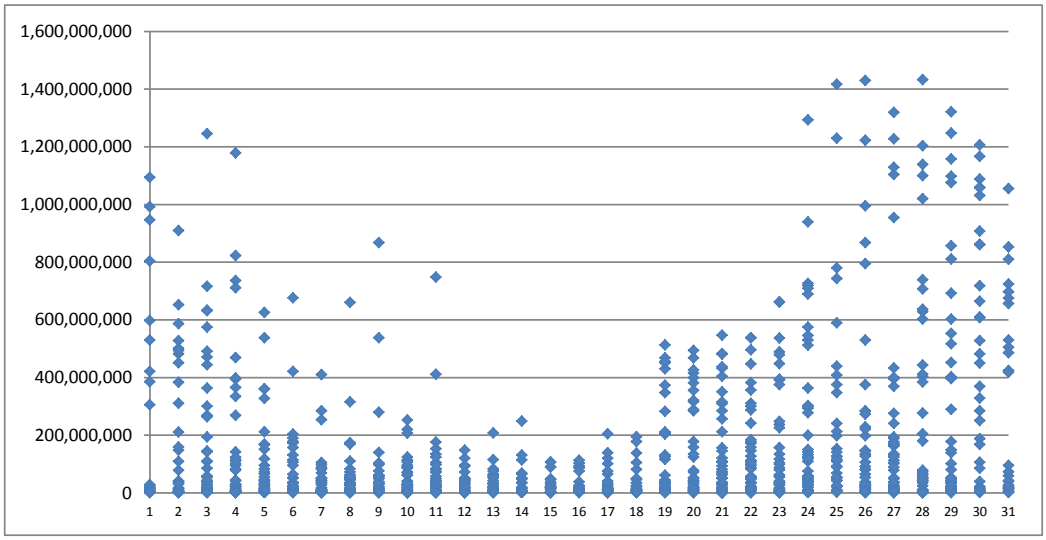

Figure 2. Frequency of transfers from the ZUS on specific days of the month between 1999 and 2011.