

A STUDY ON THE MOMENTUM EFFECT FOR THE BULGARIAN STOCK EXCHANGE: SOME PRACTICAL ISSUES OF APPLIED IMPORTANCE

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Abstract: *The momentum effect has been studied for almost three decades. It indicates the presence of return predictability patterns on financial markets, which contradicts to the Efficient Market Hypothesis. Best (worst) past securities over the short-term tend to continue to perform well (poorly) over the subsequent period of up to 12 months. This paper examines the profitability of momentum trading strategies on the Bulgarian Stock exchange. To achieve our goal, we apply an adjusted data preparation approach to reflect the characteristics of the BSE like poor liquidity and missing data. Over our sample Jan-2004 to Jul-2017 we do not find enough evidence for momentum profits. Accounting for the financial crisis, we divide our sample into three subsamples. During the pre-crisis period (Jan-2004 to Dec-2007) we find significant momentum profits and return predictability. During the subsequent crisis period from Jan-2008 to Dec-2012 momentum effects disappears, whereas it does not reappear during the post-crisis period from Jan-2013 to Jul-2017. The latter indicates, that the BSE is still undergoing the consequences of the severe market downturn.*

Keywords: *Bulgarian Stock Exchange; momentum effect; short-term return predictability; Global financial crisis 2008;*

JEL: C80, G01, G11, G17.

1. INTRODUCTION

Momentum effect represents short-term return predictability based on the performance of assets over the previous up to 12 months. Taking a long position in the past winners and going short on past losers tend to provide investors with significant profits. Identified by Jagadeesh & Titman (1993) in the early 1990s in the US stock market, this cross-sectional momentum effect persists to be apparent on international investment markets across different asset classes, including individual European stock markets (Rouwenhorst, 1998), country equity index futures, government bonds, currencies (Menkhoff, et al., 2012) and commodity futures (Asness, et al., 2013). Eugene Fama qualifies momentum as one of the more arduous factors to harmonize with the Efficient Markets Hypothesis (EMH) (Asness, 2016)¹, which is consistent to a great extent with the

¹ In his post "Fama on Momentum" Clifford S. Asness discusses an interview with Eugene Fama, where the Noble Laureate states his opinion on momentum. Eugene Fama's statements qualify momentum as the "biggest embarrassment to the theory" and one of the harder aspects to reconcile with the EMH. He also expresses the hope, that "it goes away". The complete interview with Eugene Fama could found at: <https://www.top1000funds.com/featured-homepage-posts/2015/12/11/investors-from-the-moon-fama/>. Clifford Asness is a Founder, Managing Principal and Chief Investment Officer at AQR Capital Management. He is also an active researcher in a broad range of topics in finance and investing.

argument of Jegadeesh & Titman (2011) for momentum to be the strongest evidence against EMH. Up to date a huge body of literature is engaged with the study of this phenomenon, nevertheless, the necessity to further develop and deepen this research strand onto frontier markets like the Bulgarian Stock Exchange (BSE) is evidenced by the research emphasis prevalently on developed international markets.

Our goal is to investigate the common stock equity market on the BSE and to find out, whether momentum effect is present. In addition, we propose an algorithm for data preparation that takes into account some characteristics of frontier markets such as poor liquidity resulting into numerous missing observations. Hereinafter, to examine the profitability of momentum strategies we employ the methodology for the emerging market of Vietnam proposed by Alphonse & Nguyen (2013), who replicate the one initiated by Jegadeesh & Titman (1993) only departing from it by using weekly returns instead of monthly ones.

Our research is motivated by the fact that frontier markets are still barely studied in terms of their exposure to market anomalies such as the momentum effect. Furthermore, to the best of our knowledge, the BSE has not yet been examined for the presence of momentum. At the same time, the research results of Kenourgios & Samitas (2011) are supportive to our understanding that studying the presence of momentum at the BSE is an important research task. In particular, Kenourgios & Samitas (2011) conclude that Balkan markets (Bulgaria, Romania, Croatia, Turkey) overreact to the movements, occurring in developed ones (US, UK, Germany and Greece) during the period 2000-2007. According to the authors these findings corroborate the viewpoint that momentum trading strategies are most appropriate for generating abnormal returns in emerging Balkan markets. On the other hand, Cakici et al. (2013) globally investigate momentum in emerging market stock returns. They focus on 18 markets, grouped into three emerging regions: Asia, Latin America and Eastern Europe (Turkey, Poland, Russia, Hungary and Czech Republic). The authors find strong evidence for the presence of momentum effect in all markets except Eastern Europe. Last, the findings in Ivanov et al. (2012) suggest that since 2007 BSE is remarkable for an increased level of long range dependence concerning the returns of BSE equity index – SOFIX. According to Angelov (2009) BSE has functioned almost efficiently during its earlier period, after which there are indications of imperfection. These evidences could indicate the presence of momentum effect on BSE. Moreover, focusing on the BSE, we extend the concurrent research strand into a market that could be a conceivable diversification spot especially for Euro-investors because of the stability of the Currency board, including the fixed exchange rate between the Bulgarian national currency and the Euro, established by the Bulgarian National Bank already 20 years ago.

For the achievement of our goal, we first handle the raw data, following a data preparation algorithm that accounts for the special features of the currently traded stocks on the BSE. Secondly, we adopt the methodology of Alphonse and Nguyen (2013) so as to test for presence of momentum at the BSE. Our major findings come down to the following. For the whole examined period we do not find momentum profits on BSE. This result could be explained by the fact that the BSE has been severely hit by the Great Recession of 2008 and the crisis is still on-going. That is why we divide our sample into three sub-samples: from Jan-2004 to Dec-2007, from Jan-2008 to Dec-2012 and from Jan-2013 to Jul-2017. We find significant weekly momentum profits for the pre-crisis period, whereas for the latter two periods momentum is not a good trading strategy to pursue.

Our research contributes to the existing literature on momentum by extending into a frontier market like the BSE and by employing an adjusted methodology for data preparation, that accounts for missing data and poor liquidity.

The rest of the paper is organized as follows. Section 2 provides the analytical framework in the context of literature review. The research methodology and the data are

outlined in Section 3. Section 4 presents the major research results, followed by a discussion. Section 5 concludes the study.

2. LITERATURE REVIEW

Asness et al. (2013) examine value and cross-sectional momentum strategies jointly across eight different asset classes and markets (individual stocks in the USA, UK, Europe and Japan, country equity index futures, government bonds, currencies and commodity futures), which represents a new contribution to the literature alongside with the finding of value and momentum in government bonds and value effect in currencies and commodities. Momentum profits are found to be positive in every stock market for the period 1972-2011, especially in Europe, but in Japan they are statistically insignificant as previous literature suggests. Chui, et al. (2010) argue that in the Asian region (incl. Japan) momentum effect yields negative returns.

Narayan et al. (2015) prove the profitability robustness of commodity futures market, using not only one but three trading strategies for the time period Apr-1986 to Aug-2010. The most profitable commodity is oil, followed by silver, platinum and gold. Testing for the relevance of short-selling, Narayan et al. (2015) conclude, that applying it together with long positioning leads to higher profits.

Foltice & Langer (2015) question the proposition of momentum trading, regarding short selling of stocks, because it is not feasible for individual investors due to the following practical reasons: capability of undertaking these positions, the severe risk of uprising prices, fees and margin requirements. The authors conclude, that taking only long positions in past 6-month best performing one to 50 stocks on NYSE for a 12-month holding period is profitable for individual investors, measured monthly. Transaction costs and risk are accounted for, as initial investment amounts range between \$5,000 to \$1,000,000 and sample period covers the years from 1991 to 2010.

Daniel & Moskowitz (2016) examine momentum crashes, their potential sources and predictability based on conditional risk measures. Momentum strategies crash following market declines. Negative profits are persistent due to their negative skewness and to some extent forecastable. As stated by Grundy & Martin (2001), during significant market downturns winner stocks are those with low beta and losers – with high. Thus, if the formation period coincides with declines, the momentum portfolio would consist of low-beta past winner stocks and high-beta past loser stocks. When the market rebounds quickly, the momentum portfolio would have a conditionally large negative beta. Daniel & Moskowitz (2016) empirically verify the presence of severe time variation in the betas of momentum portfolios. They find, that only in bear markets there is a double statistically significant difference between momentum portfolio's up and down-market beta (-1.51 versus -0.70), which is mostly driven by the past losers. That is why momentum portfolios gain a little in market declines and lose a lot in market rebounds.

Chabot et al. (2014) use a combination of self-collected historical data set of the Victorian London Stock Exchange (1867 to 1907) and existing data from CRSP United States (1926 to 2012). They find that momentum investing strategy earned abnormal returns across both eras: a three-factor alpha of 0.5 percent per month in Victorian London and 1 percent per month in CRSP era. However, still in practice momentum trading undergoes rare periodic crashes in both eras, exposing investors to severe losses, where momentum effect disappears, only to reappear later. According to the authors the occurrence of crashes predetermines the persistence of momentum strategy.

3. METHODOLOGY

Our methodology replicates the procedure outlined by Alphonse & Nguyen (2013) that is applied to the Vietnamese stock market. As already explained in the introduction section the algorithm of Alphonse & Nguyen (2013) is found to be well-suited to the momentum analysis of emerging markets. However, we should emphasize the fact that even though the Vietnamese stock market is emerging, it is characterized by significantly larger market capitalization as well as higher liquidity. Also, the number of listed companies is greater than that of the Bulgarian stock exchange. All these features require careful preliminary data analysis and preparation so as to enable adoption of the aforementioned procedure. With the text that follows, we provide a detailed description of the algorithm designed for the preliminary data analysis and preparation. The exhibition is presented step by step thus the process might be replicated when momentum analysis is performed for stock markets with similar characteristics to the Bulgarian stock exchange.

3.1. Data preparation

When imported in MATLAB, there are altogether 90 stocks with a history spanning from 1-Jan-2000 to 31-Jul-2017. The data is sampled on weekly basis². The dataset contains missing values that should be filled. It is worth to note that interpolation is needed as the modification of the Jagadeesh & Titman (1993) methodology, introduced by Alphonse & Nguyen (2013), requires all stocks considered at each particular iteration to have a return history of 104 weeks in a row. Thus, if only complete records are considered, the number of stocks satisfying the latter requirement are found to be insufficient to construct portfolios. We should further emphasize on the fact that the choice of proper interpolation technique is crucial for the subsequent analysis. Simple techniques such as those relying on the nearest value or linear interpolation would hamper the momentum analysis as the filled missing prices would result either into zero-valued returns (in case of using nearest value) or returns with a trend (in case of utilizing linear interpolation).

Unlike linear interpolation, spline reconstruction is well-suited to stock market data as the latter are characterized by very complicated structure with multiple spikes and declines with apparently irregular fashion. Moreover, significant body of literature engaged with the study of stock price inefficiencies (see for example the paper of Bogdanova & Ivanov (2015) and the references therein) evidences on possibilities for prediction through application of nonlinear models that might be applied for both extrapolation and interpolation purposes. Even though spline functions capture efficiently nonlinearities, they are characterized by significant level of flexibility that is easily tuned via a number of nodes thus avoiding the issue of instability that is associated with higher order polynomial interpolation. As suggested in chapter 2 of Holton (2014) the method of cubic spline interpolation is widely used in finance. Therefore, in this paper we would rely on spline interpolation. Furthermore, we find that in terms of this particular data set, spline interpolation is compliant to the requirements on the choice of a procedure for filling missing observations that are outlined by Lazarov (2013).

² It is worth mentioning, why we rely on weekly returns just like Alphonse & Nguyen (2013) instead of monthly returns as in the seminal paper of Jagadeesh & Titman (1993). Our choice is motivated by the length of the investigated sample – from January 2004 to July 2017 or a total of 163 months. The number of monthly observations would not be enough for the objectives of our analysis. Bearing in mind, that we should construct both formation and holding periods and that we analyse sub-periods, each of length between 4 and 5 years to account for the effect of the Global Financial Crisis, monthly observations would not be appropriate from statistical point of view. For instance, if we employ a maximum of 12-month formation period beginning in Jan-2004, then the corresponding holding period would start in Jan-2005. That is why, we stick to the investigation of weekly returns.

Yet, prior to the conduction of spline interpolation, we identify all stocks with a trading history of 27 or more weeks thus when prices are transformed to returns, all considered stocks will have return history of at least 26 weeks. This is solely for the purpose of constructing formation and holding periods, each of at least 13 weeks length³. Consequently, we proceed as follows. Firstly, the start as well as the end trading date is identified for each stock and the spanning period between these two dates is calculated in weeks. Then, all stocks with a spanning period of 26 or less weeks are removed from our sample. In this particular case only two stocks are excluded from the sample⁴ thus the number of stock considered further is 88. In Appendix A is provided a complete list of all stocks considered in the further analysis.

As already explained the next step in our preliminary analysis comes down to filling missing values for each particular stock retained in the sample through cubic spline interpolation. This procedure is performed only for the period spanning between the first and the last trading date. The delivered results are visualized at Figure B1 to Figure B10 in Appendix B. After a close inspection of figures, we note the following issues. First of all, some of the stocks, such as stock № 16 or stock № 17 for instance, are characterized by just few price observation for the period spanning from the first to the last trading date. Therefore, the corresponding price series is almost entirely reconstructed via the spline interpolation. Including such stocks when constructing portfolios might bias severely results and lead to unreliable conclusions. Consequently, all stocks with a number of missing observations commensurate with or greater than the number of available price records are excluded from our sample⁵. After completing this step the remaining sample consists of 69 stocks altogether. Appendix C provides a list with the names of these companies and we have applied a consecutive numbering to them, while visual representation is available in Appendix D.

Another issue with some of the stocks retained in the sample is the occurrence of negative prices as a result of interpolation. This finding holds true especially for earlier periods of operation of the Bulgarian stock exchange where due to infrequent trading significant number of consecutive observations are missing. A visual inspection suggests that sample periods prior to Jan-2004 might be excluded thus the aforementioned issue would be resolved for most of the stocks. Yet, companies 17, 25, 30, 40, 56, and 58 as numbered in Appendix C are characterized by negative interpolated prices for the period beyond January 2004. Our approach in this case includes the exclusion of all such periods for the corresponding six companies.

In addition, the weekly data for two of 69 stocks had to be adjusted for stock splits. These are TK-HOLD AD (T24) and Unifarm AD (59X). At the beginning of Jul-2014 the General Assembly of shareholders of T24 took a decision for a double increase of common equity through distribution of newly issued shares among current shareholders as dividends, sourcing from retained and current earnings. The stock split occurred on the 21-Jul-2014, so we doubled all subsequent prices for T24 till the end of the sample. In comparison, there were two stock splits, committed by the General Assembly of 59X: on the 08-Dec-2008 the common equity was doubled through distribution of newly issued shares as dividends to stockholders and on the 05-Jul-2010 the common equity was increased six-fold. That is why,

³ Technically speaking, we run tests for significant momentum with formation and holding periods of up to 52 weeks. However, a requirement on a timespan of at least 105 weeks between the first and the last date of trade is quite limiting, as this would potentially exclude recently listed stocks even for shorter formation and holding periods. Furthermore, as suggested in Alphonse & Nguyen (2013), it is of particular interest to study portfolios with a formation and a holding period of up to 13 weeks. Therefore, we decide to set up minimum timespan required to 27 weeks.

⁴ These are the stocks of Neo London Capital EAD (178B) and Fenix Capital Holding AD (0PH).

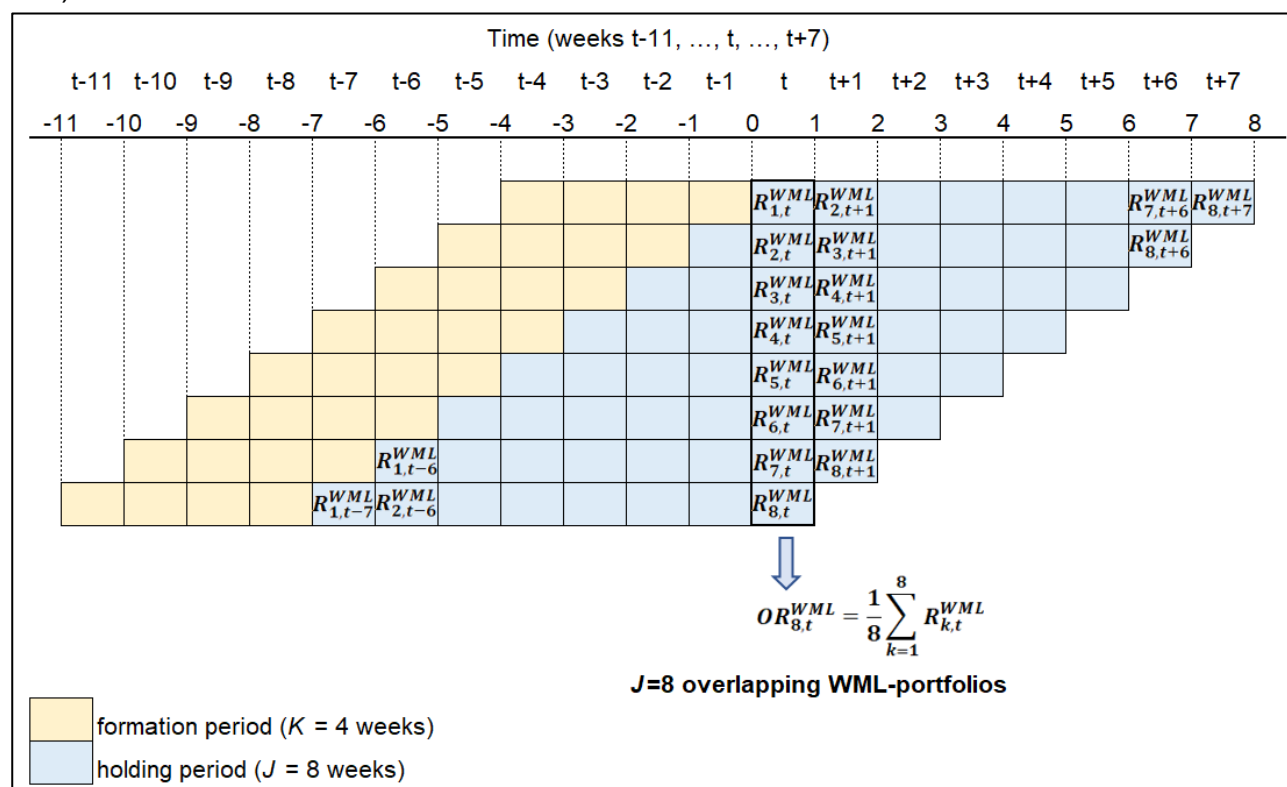
⁵ In particular, these are stocks with the following numbers: 14, 16, 17, 19, 23, 42, 44, 45, 47, 49, 53, 57, 68, 70, 73, 78, 82, 84, 87. The reader might find the names of the corresponding companies in Appendix A.

we first doubled the stock price for the time period between the two stock splits. For the remaining period till the end of the sample we multiplied it by twelve.

3.2. Construction of a momentum strategy

As already mentioned we would use the procedure developed by Alphonse & Nguyen (2013), which is briefly described below. Rest of this section follows closely the presentation in at pp. 188-189 of Alphonse & Nguyen (2013). In week t we divide stocks into quintiles according to their average lagged returns over the past K weeks ($K = 1, 2, 4, 8, 13, 26, 39$ and 52 weeks – formation period). Thus, we examine 64 different momentum strategies. Since our sample starts with 35 stocks and by the end of the investigated period it consists of 69 stocks altogether, each portfolio consists of 7 up to 14 stocks except the median one with 13 stocks. The stocks in the highest and lowest quintile are called respectively “winners” and “losers”. Using quintiles instead of quantile as in Jegadeesh & Titman (1993) is a standard practice in research literature of emerging markets due to the limited number of securities and the need for a certain degree of portfolio diversification (Muga & Santamaria, 2007).

Figure 1: Eight overlapping WML-portfolios for the momentum investment strategy ($K=4$; $J=8$)



We weight all component stocks in both portfolios equally. As in the classical approach, transaction costs are not allowed for. That is why, the constructed winner-minus-loser-portfolio (WML) is called a zero-cost portfolio, consisting of a long position in “winners” and a short one in “losers” from week t to week $t+J$ ($J = 1, 2, 4, 8, 13, 26, 39$ and 52 weeks – the holding period). Hence, we use the term profit instead of return on WML. Consequently, the raw profits for WML portfolios in a given week t are denoted by: $R_{k,t}^{WML}$ ($k = 1, \dots, J$). The subscript k stands for the fact, that we calculate the profit of a given WML-portfolio ($K; J$), held in a particular week within the holding period of J weeks. As common in literature, we

examine overlapping portfolios, since at week t there are J WML portfolios⁶, that have been formed in week $t-1, t-2, \dots, t-J$. Their profits in a given calendar week t are equally averaged:

$$OR_{J,t}^{WML} = \frac{1}{J} \sum_{k=1}^J R_{k,t}^{WML} \quad (1)$$

It is worth mentioning, that the overlapping returns for the both the winner and the loser portfolios in a given week t is similarly calculated. Afterwards, we compute the average of the overlapping profit on the WML portfolio as a metric to test the momentum on the BSE. If the metric is significantly positive, momentum effect occurs, otherwise it is not present. Figure 1 depicts the discussed overlapping principle, using the example of the momentum trading strategy ($K=4$; $J=8$).

4. RESEARCH RESULTS

4.1. Evidence on the momentum effect

Table 1. Average raw weekly returns and profits on winner, loser and winner-minus-loser (WML) portfolios in percent points (Jan-2004 to Jul-2017). T-statistics are also presented.

| K | J | 1 | | 2 | | 4 | | 8 | | 13 | | 26 | | 39 | | 52 | |
|----|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 1 | Winners | 1.62% | 8.8354 | 0.83% | 5.4941 | 0.62% | 4.4824 | 0.67% | 5.2891 | 0.68% | 5.6367 | 0.67% | 5.6096 | 0.53% | 4.7470 | 0.43% | 4.0696 |
| | Losers | 0.40% | 2.3030 | 1.03% | 6.5066 | 1.15% | 8.3148 | 0.91% | 7.1451 | 0.80% | 6.3867 | 0.70% | 5.8632 | 0.58% | 5.1049 | 0.45% | 4.1519 |
| | WML | 1.22% | 5.5216 | -0.20% | -1.2491 | -0.53% | -5.5679 | -0.24% | -3.6115 | -0.12% | -2.2911 | -0.03% | -0.8928 | -0.05% | -1.9256 | -0.02% | -0.8333 |
| 2 | Winners | 0.79% | 4.5033 | 0.41% | 2.7455 | 0.43% | 3.0357 | 0.59% | 4.5468 | 0.65% | 5.2619 | 0.65% | 5.4210 | 0.51% | 4.5930 | 0.41% | 3.9653 |
| | Losers | 1.20% | 6.9505 | 1.41% | 9.0213 | 1.26% | 9.0775 | 0.96% | 7.5483 | 0.84% | 6.7257 | 0.71% | 5.9861 | 0.59% | 5.1788 | 0.44% | 4.1224 |
| | WML | -0.42% | -1.9452 | -1.00% | -6.2802 | -0.83% | -6.8717 | -0.37% | -4.2893 | -0.19% | -2.8312 | -0.06% | -1.3197 | -0.07% | -2.1269 | -0.02% | -0.8077 |
| 4 | Winners | 0.23% | 1.3950 | 0.11% | 0.7286 | 0.34% | 2.3698 | 0.56% | 4.2580 | 0.64% | 5.0660 | 0.66% | 5.4183 | 0.49% | 4.4068 | 0.41% | 3.9142 |
| | Losers | 1.46% | 8.8020 | 1.50% | 9.6857 | 1.19% | 8.5749 | 0.88% | 6.9182 | 0.78% | 6.3981 | 0.65% | 5.6876 | 0.53% | 4.7957 | 0.40% | 3.7692 |
| | WML | -1.23% | -6.0966 | -1.39% | -8.5765 | -0.84% | -6.0105 | -0.33% | -3.3200 | -0.14% | -1.6937 | 0.00% | 0.0508 | -0.04% | -0.8236 | 0.01% | 0.2036 |
| 8 | Winners | 0.37% | 2.2919 | 0.23% | 1.5229 | 0.39% | 2.6742 | 0.62% | 4.5810 | 0.71% | 5.3309 | 0.65% | 5.2531 | 0.47% | 4.1424 | 0.38% | 3.6269 |
| | Losers | 1.35% | 8.1821 | 1.34% | 8.6672 | 1.03% | 7.4323 | 0.77% | 5.9687 | 0.65% | 5.3642 | 0.57% | 4.8818 | 0.46% | 4.1640 | 0.32% | 3.0529 |
| | WML | -0.98% | -5.0690 | -1.11% | -6.6121 | -0.64% | -4.3182 | -0.15% | -1.2105 | 0.06% | 0.5954 | 0.09% | 1.0859 | 0.02% | 0.2582 | 0.06% | 1.0997 |
| 13 | Winners | 0.47% | 2.9655 | 0.42% | 2.8595 | 0.55% | 3.7570 | 0.70% | 4.8959 | 0.75% | 5.2430 | 0.65% | 4.9348 | 0.48% | 4.0025 | 0.39% | 3.5452 |
| | Losers | 1.07% | 6.7121 | 1.08% | 7.3184 | 0.93% | 6.7566 | 0.68% | 5.2719 | 0.59% | 4.8334 | 0.51% | 4.3160 | 0.41% | 3.6615 | 0.29% | 2.7606 |
| | WML | -0.60% | -3.1559 | -0.65% | -3.9424 | -0.38% | -2.4507 | 0.02% | 0.1284 | 0.16% | 1.2682 | 0.14% | 1.3930 | 0.07% | 0.8570 | 0.10% | 1.2864 |
| 26 | Winners | 0.68% | 4.0471 | 0.59% | 3.6298 | 0.69% | 4.3670 | 0.77% | 5.0702 | 0.75% | 5.0917 | 0.53% | 3.9070 | 0.41% | 3.3074 | 0.40% | 3.4740 |
| | Losers | 0.73% | 5.2858 | 0.82% | 5.9899 | 0.69% | 5.2493 | 0.51% | 4.0419 | 0.44% | 3.5720 | 0.38% | 3.2585 | 0.28% | 2.4553 | 0.30% | 2.7063 |
| | WML | -0.05% | -0.2805 | -0.23% | -1.3782 | 0.00% | 0.0099 | 0.26% | 1.7744 | 0.31% | 2.2548 | 0.14% | 1.1720 | 0.13% | 1.1503 | 0.11% | 1.0233 |
| 39 | Winners | 0.45% | 2.9505 | 0.40% | 2.7418 | 0.46% | 3.0818 | 0.50% | 3.4829 | 0.51% | 3.6459 | 0.38% | 3.0390 | 0.37% | 3.0689 | 0.30% | 2.6110 |
| | Losers | 0.74% | 5.1758 | 0.79% | 5.5744 | 0.64% | 4.6581 | 0.48% | 3.6585 | 0.43% | 3.3709 | 0.33% | 2.7007 | 0.34% | 2.8205 | 0.29% | 2.6039 |
| | WML | -0.29% | -1.6633 | -0.39% | -2.3749 | -0.18% | -1.1129 | 0.02% | 0.1616 | 0.09% | 0.5980 | 0.05% | 0.4113 | 0.04% | 0.3085 | 0.00% | 0.0453 |
| 52 | Winners | 0.43% | 2.8513 | 0.35% | 2.3785 | 0.38% | 2.6300 | 0.41% | 2.9957 | 0.43% | 3.1877 | 0.41% | 3.1879 | 0.41% | 3.1879 | 0.27% | 2.4243 |
| | Losers | 0.66% | 4.6998 | 0.67% | 4.7539 | 0.56% | 4.0335 | 0.37% | 2.7644 | 0.34% | 2.6202 | 0.36% | 2.8681 | 0.36% | 2.8681 | 0.29% | 2.5621 |
| | WML | -0.22% | -1.3366 | -0.32% | -1.9701 | -0.17% | -1.1172 | 0.04% | 0.2681 | 0.08% | 0.5831 | 0.05% | 0.3440 | 0.05% | 0.3440 | -0.01% | -0.1335 |

Table 1 presents the average raw returns and profits on the winner, loser and WML portfolios, which select stocks based on their average returns over past K weeks and hold them for J weeks ($K=1, 2, 4, 8, 13, 26, 39$ and 52 , $J=1, 2, 4, 8, 13, 26, 39$ and 52). The majority of the returns and profits are statistically significant. The empirical results for the whole sample period from Jan-2004 to Jul-2017 show, that 39% of the implemented momentum trading strategies are profitable, but still the majority of them are negative. The most profitable WML portfolio ($K=1$ and $J=1$) earns profit of 1.22% per week, which is substantial. However, other profitable momentum portfolios yield profits, that range between 0.01% and 0.31% and approximately refer to the strategies for $K \geq 8$ and $J \geq 8$ weeks. It is worth to mention, that among them only the WML portfolio ($K=26$ and $J=13$) earns a statistically significant profit of 0.31% per week (t -stat. = 2.2548), while the profits of the other portfolios are not significant, but they consist of statistically significant winner and loser

⁶ This means, that in those weeks, when there are less than J overlapping WML-portfolios, we do not compute a mean value, because such action would bias our results.

portfolios. On the other hand, the highest WML portfolio loss amounts to -1.39% ($K=4$; $J=2$) (t -stat. = -8.5765), while other losses vary between -0.01% and -1.23%, as the majority of them is statistically significant. It is obvious, that the magnitudes of losses are greater than those of profits. Over all, momentum strategies are not to pursue on the BSE based on the whole sample. Still, the mixture of profits and losses is an interesting evidence.

Bird et al. (2017) undertake a comparative analysis of cross-sectional and time series momentum in 24 international equity markets between 1990 and 2012. They apply 768 different strategy implementations for both types of momentum, differing in weighting, rebalancing periods, cut-off points and the combination of formation and holding periods. For the US equity market, they found, that neither form of momentum performs particularly well over the whole sample period. This a surprising finding in comparison to most of the cross-sectional momentum studies on the US equity market, that found the strategy to be highly profitable. Bird et al. (2017) interpret their results with the argument, that momentum strategies performed extremely worse than other markets during the Global Financial Crisis (GFC). That is why, we think, that our mixed results are due to the bad performance of the BSE during the crisis.

To test our hypothesis, we divide our sample into three almost equal time periods: from Jan-2004 to Dec-2007, from Jan-2008 to Dec-2012 and from Jan-2013 to Jul-2017. We undertook this particular sample division, motivated by Mileva (2014), who investigated the problems on the BSE during the financial crises. The author states, that the time period 2003-2006 represented a market boom with predominantly increasing stock prices, driven rather by capital inflows than by artificial reasons. BSE realizes its highest results ever in 2007. The annual registered volume of 9,946 billion Leva is three times as big as the one in 2006. There are also an 200%-increase in realized trades. Mileva (2014) argues, that the GFC has also hit regional market, that are relatively more closed like the BSE. The equity stock indexes like SOFIX and BG-40 have decreased by around 300-350% from 2008 to 2010. Their decline as of 2011 on annual basis, compared to 2010, amounts to 10%. First signs of market rebound on an annual basis occurred in 2012, when the volume on the regulated market increased by 9.36%. the following 2013 marks increases for all the equity indexes on the BSE (SOFIX by over 43%, BG-40 – by 27% and BGTR30 – by almost 12%). That is why, we decide to isolate the period of the GFC between Jan-2008 and Dec-2012 from the pre-crisis boom period and the post-crisis one.

4.2. Momentum effect within the pre-crisis subsample

We are now examining only the stock price movements for the boom period on the BSE: Jan-2004 to Dec-2007. Table 2 presents the empirical results for the average returns on both the winner and loser portfolios and the average profits on the WML portfolios on weekly basis, constructed the same way as in the previous case. All returns of both the winner and the loser portfolios are statistically significant. With regard to the WML portfolios the profits of the majority of them (47 of 64 strategies or over 73%) are statistically significant and for almost all K and J weeks they are severely positive. Thus, we encountered the presence of momentum effect on the BSE for the pre-crisis period of market boom. The most profitable momentum strategy is again the WML portfolio ($K=1$ and $J=1$), earning 1.46% per week (t -stat. = 2.6522). This evidence implies, that there is a strong predictability of the coming one-week returns, based on the realized ones for the same time period in the past. Possible explanation for this could be the traditional low liquidity on the BSE. The WML portfolio returns vary between 1.46% for the WML portfolio ($K=1$; $J=1$) and -0.34% (t -stat. = -0.8658) for ($K=4$; $J=2$), implying a mean value of 0.58% per week or 2.32% per month for all 64 WML strategies. This mean result is almost twice as high as the corresponding one, estimated by Muga & Santamaria (2007) for the emerging markets region of Latin America

(Argentina, Chile, Mexico and Brazil), using only the traded stocks between Jan-1994 and Jan-2005, that are included in the national stock indexes - Indice General, IPSA, IPC and Bovespa.

Table 2: Average raw weekly returns and profits on winner, loser and winner-minus-loser (WML) portfolios in percent points (Jan-2004 to Dec-2007). T-statistics are also presented.

| K | J | 1 | | 2 | | 4 | | 8 | | 13 | | 26 | | 39 | | 52 | |
|----|---------|--------|---------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 1 | Winners | 3.23% | 7.1447 | 2.47% | 7.0244 | 2.29% | 7.5064 | 2.33% | 8.4151 | 2.26% | 8.8303 | 1.90% | 7.9918 | 1.43% | 6.8091 | 1.03% | 5.8661 |
| | Losers | 1.77% | 4.7705 | 2.11% | 6.6860 | 2.23% | 7.8883 | 2.00% | 8.2088 | 1.99% | 8.4945 | 1.75% | 7.8737 | 1.37% | 6.7740 | 0.94% | 5.6267 |
| | WML | 1.46% | 2.6522 | 0.36% | 0.9848 | 0.06% | 0.2507 | 0.33% | 2.0835 | 0.27% | 2.3467 | 0.15% | 1.7920 | 0.06% | 1.1004 | 0.09% | 2.1017 |
| 2 | Winners | 2.69% | 6.3134 | 2.36% | 6.7914 | 2.23% | 7.2336 | 2.32% | 8.3037 | 2.30% | 8.8314 | 1.92% | 8.0397 | 1.44% | 6.8626 | 1.01% | 5.9080 |
| | Losers | 2.20% | 6.3427 | 2.31% | 7.1983 | 2.17% | 7.6831 | 1.94% | 8.2568 | 1.93% | 8.4815 | 1.69% | 7.9192 | 1.34% | 6.6467 | 0.89% | 5.4767 |
| | WML | 0.49% | 0.9608 | 0.05% | 0.1331 | 0.06% | 0.2159 | 0.39% | 1.8690 | 0.37% | 2.3830 | 0.22% | 2.1851 | 0.10% | 1.2977 | 0.13% | 2.2474 |
| 4 | Winners | 2.04% | 5.3413 | 1.87% | 5.6522 | 2.12% | 6.5992 | 2.24% | 7.9281 | 2.27% | 8.2819 | 1.90% | 7.6339 | 1.35% | 6.5245 | 0.98% | 5.5023 |
| | Losers | 2.28% | 6.5782 | 2.21% | 6.7299 | 1.85% | 6.7247 | 1.64% | 7.0421 | 1.73% | 8.0145 | 1.54% | 7.7591 | 1.14% | 6.3025 | 0.78% | 4.9976 |
| | WML | -0.24% | -0.5154 | -0.34% | -0.8658 | 0.27% | 0.8396 | 0.60% | 2.6236 | 0.54% | 2.7814 | 0.36% | 2.6212 | 0.21% | 1.9709 | 0.20% | 2.4329 |
| 8 | Winners | 2.41% | 6.0682 | 2.25% | 6.5348 | 2.25% | 6.8938 | 2.39% | 7.7602 | 2.36% | 8.0562 | 1.86% | 7.3310 | 1.26% | 5.9968 | 0.88% | 5.1664 |
| | Losers | 1.81% | 5.6930 | 1.80% | 5.9843 | 1.43% | 5.7088 | 1.44% | 6.4174 | 1.53% | 7.0734 | 1.33% | 6.6971 | 0.96% | 5.5351 | 0.54% | 4.2064 |
| | WML | 0.60% | 1.3296 | 0.45% | 1.1541 | 0.82% | 2.4471 | 0.94% | 3.1704 | 0.83% | 3.2157 | 0.54% | 2.8855 | 0.30% | 2.0524 | 0.34% | 2.7957 |
| 13 | Winners | 2.71% | 7.0184 | 2.57% | 7.2742 | 2.48% | 7.1517 | 2.39% | 7.2276 | 2.38% | 7.4947 | 1.79% | 6.5884 | 1.27% | 5.6154 | 0.94% | 5.0025 |
| | Losers | 1.40% | 5.4076 | 1.45% | 5.7164 | 1.40% | 5.9406 | 1.35% | 6.0022 | 1.42% | 6.6320 | 1.16% | 5.7974 | 0.83% | 4.7508 | 0.46% | 3.5815 |
| | WML | 1.31% | 3.1493 | 1.12% | 2.9654 | 1.08% | 2.9730 | 1.04% | 3.2030 | 0.95% | 3.3357 | 0.63% | 2.8391 | 0.45% | 2.4995 | 0.48% | 3.0467 |
| 26 | Winners | 2.37% | 5.9885 | 2.27% | 6.0682 | 2.34% | 6.4116 | 2.31% | 6.7986 | 2.17% | 6.7706 | 1.42% | 5.3461 | 1.02% | 4.6833 | 1.05% | 5.7093 |
| | Losers | 1.14% | 4.7190 | 1.17% | 4.9251 | 1.09% | 4.7895 | 0.96% | 4.4271 | 0.95% | 4.5935 | 0.73% | 4.0119 | 0.43% | 3.0954 | 0.50% | 4.5064 |
| | WML | 1.23% | 3.0589 | 1.10% | 3.0281 | 1.25% | 3.6440 | 1.34% | 4.2987 | 1.21% | 4.2779 | 0.69% | 2.8628 | 0.60% | 2.9292 | 0.55% | 3.0230 |
| 39 | Winners | 2.04% | 5.3938 | 1.97% | 5.6729 | 1.96% | 5.6141 | 1.75% | 5.3672 | 1.70% | 5.5990 | 1.12% | 4.6911 | 1.05% | 5.1519 | 0.82% | 4.6285 |
| | Losers | 0.87% | 3.6379 | 0.91% | 3.7735 | 0.80% | 3.4728 | 0.80% | 3.6976 | 0.78% | 3.9616 | 0.45% | 2.9819 | 0.54% | 4.1892 | 0.37% | 3.6746 |
| | WML | 1.17% | 3.1494 | 1.05% | 3.1006 | 1.16% | 3.4075 | 0.95% | 3.0636 | 0.92% | 3.2414 | 0.67% | 2.9437 | 0.51% | 2.4791 | 0.45% | 2.5596 |
| 52 | Winners | 1.53% | 4.3369 | 1.43% | 4.2374 | 1.44% | 4.3360 | 1.30% | 4.3966 | 1.32% | 4.8066 | 1.21% | 5.1999 | 0.85% | 4.2461 | 0.78% | 4.7201 |
| | Losers | 0.81% | 3.7909 | 0.81% | 3.7642 | 0.81% | 3.9014 | 0.64% | 3.3556 | 0.63% | 3.6572 | 0.59% | 4.1257 | 0.44% | 3.8595 | 0.30% | 3.5609 |
| | WML | 0.72% | 2.0579 | 0.62% | 1.8194 | 0.63% | 1.9442 | 0.65% | 2.1925 | 0.69% | 2.5808 | 0.62% | 2.6473 | 0.42% | 2.0234 | 0.47% | 2.9508 |

Figure 2 shows graphical representations of the dependence between formation and holding periods. We could state, that the shorter the formation period - K , the worse the return predictability for the WML portfolio is, as J increases and tends to 52 weeks. This means, that longer-horizon past returns provide more substantial information than short-horizon past returns in predicting future returns. This implication stems from the position of the shorter-horizon formation period curves ($K = 1, 2, 4$ and 8). They lie below longer-horizon formation curves ($K = 13, 26, 39$ and 52).

In addition, independent from the length of the formation period the profits of momentum portfolios tend to decrease on weekly basis, as the holding period exceeds 8 weeks. Graphically, almost all the formation period curves remark a monotone decline after $J=8$ weeks. This evidence indicates, that the more profitable momentum strategies require the WML portfolio to be hold for 8 weeks.

What is more, Figure 3 additionally depicts the effect of the length of the formation period on the profitability of the momentum strategy without respect to the holding period. Each of the eight points in Figure 3 is constructed on the basis of the average arithmetic mean of the profits of all eight WML portfolios for a given formation period. The profits of each of the eight portfolios for a given K , that are averaged, are depicted in Figure 2 in the box below the x-axis.

The momentum trading strategy, based on the lagged 26 week returns reports the highest average profit for all holding periods, as depicted in Figure 3. This evidence indicates, that future short-term profits are best predicted by the past 6-month returns on the BSE for the pre-crisis period. Thus, bearing in mind the conclusions from Figure 2 and Figure 3, we could state, that WML portfolio with ($K=26$; $J=8$) earns an optimal profit for investors in the amount of 1.34% per week. This figure is slightly lower than the most profitable momentum strategy ($K=1$; $J=1$), but the latter is associated with more frequent portfolio

rebalancing. Thus, transaction costs would be higher and the profit would decline. That is why, we treat WML ($K=26$; $J=8$) as the better alternative.

Figure 2: WML portfolio profits for different K values ($K = 1, 2, 4, 8, 13, 26, 39$ and 52 weeks)

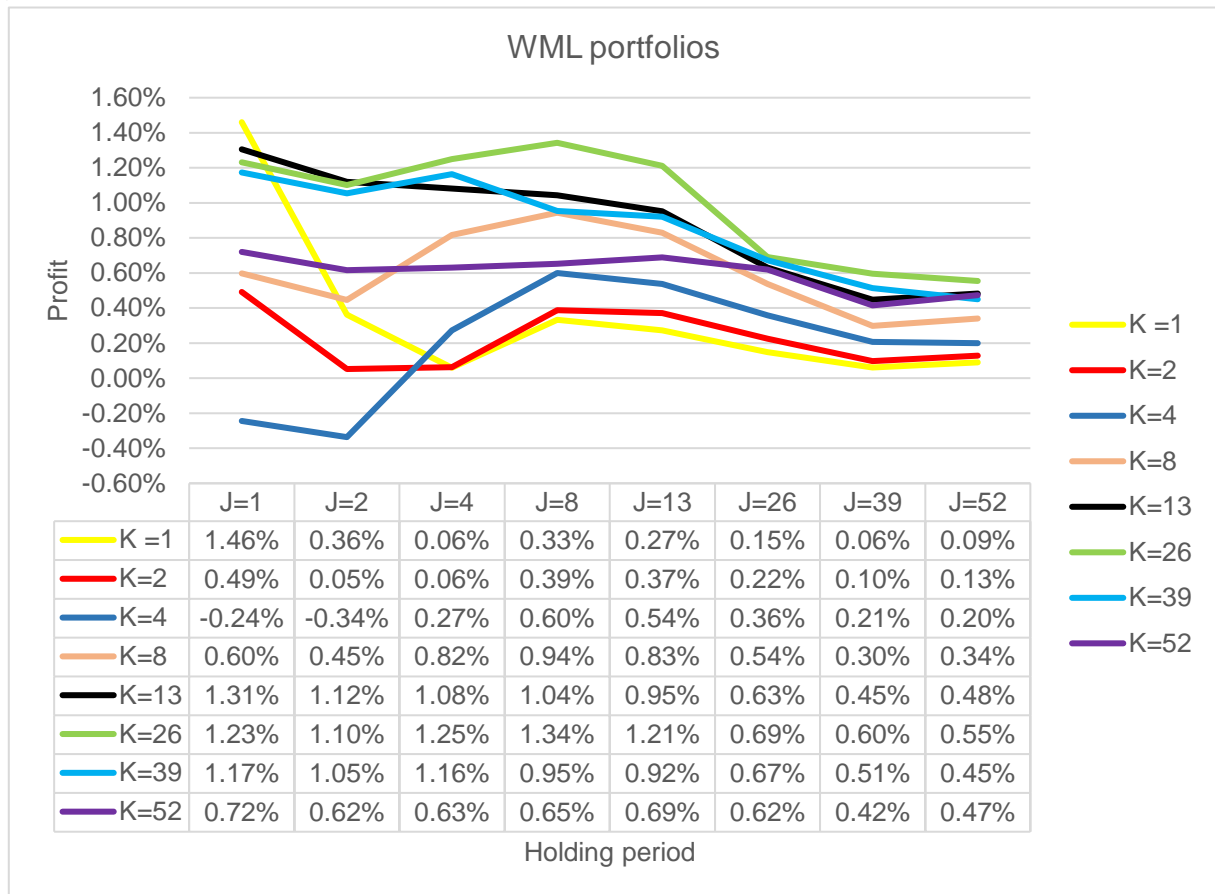
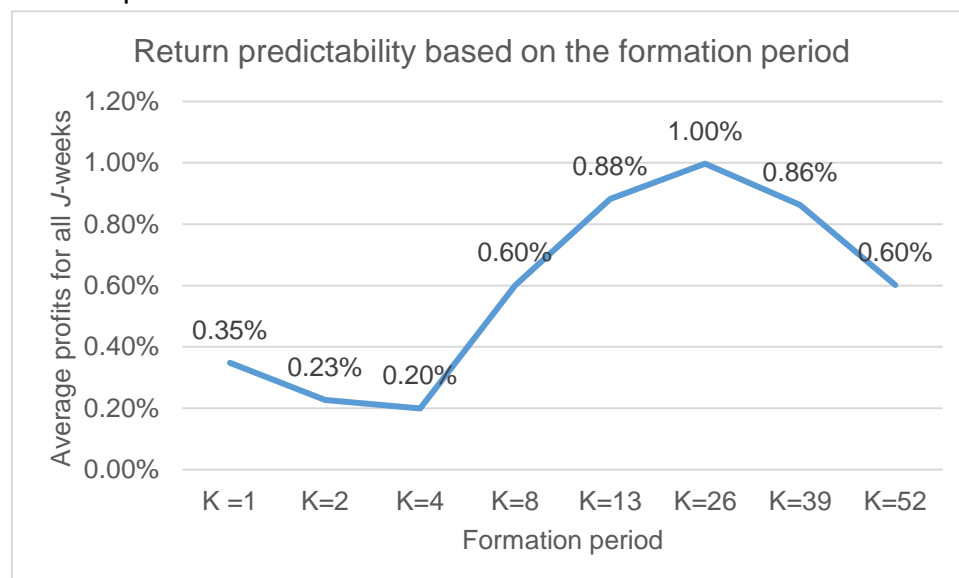


Figure 3: Estimation of average future return predictability for all J weeks, based on the length of formation period - K



The momentum trading strategy, based on the lagged 26 week returns reports the highest average profit for all holding periods, as depicted in Figure 3. This evidence indicates, that future short-term profits are best predicted by the past 6-month returns on the

BSE for the pre-crisis period. Thus, bearing in mind the conclusions from Figure 2 and Figure 3, we could state, that WML portfolio with ($K=26$; $J=8$) earns an optimal profit for investors in the amount of 1.34% per week. This figure is slightly lower than the most profitable momentum strategy ($K=1$; $J=1$), but the latter is associated with more frequent portfolio rebalancing. Thus, transaction costs would be higher and the profit would decline. That is why, we treat WML portfolio ($K=26$; $J=8$) as the better alternative.

What is more, Figure 2 shows further remarkable pattern. For all formation periods – K , the profits of $J=2$ momentum strategies substantially decrease on a weekly basis in comparison to the WML portfolios, held for one week ($J=1$). This decline varies from 0.10% for strategy ($K=52$; $J=2$) to 1.10% for ($K=1$; $J=2$) in absolute terms, compared respectively to the profits of ($K=52$; $J=1$) and ($K=1$; $J=1$). Strategies ($K=4$; $J=1$) and ($K=4$; $J=2$) are even not to be pursued. This evidence could be interpreted by the findings of Jagadeesh (1990) and Lehmann (1990). They examine the performance of contrarian strategies, that buy past losers and sell past winners. Formation periods of one week to one month are used. The empirical results show, that for the subsequent holding period of equal length, such strategies, opposite to momentum effect, yield significant profits. Thus, such very short-term return reversals could explain the graphical decreasing movement of all eight formation period curves in the second holding week ($J=2$). To avoid such microstructural biases or the contamination of the results by these reversals, Jagadeesh & Titman (1993) skip a period of one week between formation and holding periods. Later researches like Moskowitz and Grinblatt (1999) propose the skipping of one-month period, which has become a generalized standard practice. In the particular case on the BSE it should be emphasized, that we do not observe negative returns of the winner portfolios in the two-week holding period, but still they decline at the expense of loser portfolios, that remark improved performance.

From the accumulated results in table 2 it is obvious, that loser stocks have always realized positive returns. Thus, they do not contribute at all for momentum profits, their effect is even diminishing. As earlier discussed, they are even higher than those of winners for the strategies ($K=4$; $J=1$) and ($K=4$; $J=2$). These results coincide with momentum literature. According to Jegadeesh & Titman's (1993) and Grinblatt & Moskowitz's (1999) findings the abnormal performance of momentum trading is mainly due to the winner portfolio rather than the loser portfolio. Jegadeesh and Titman (1993) investigate the US stock market, including stocks from the NYSE and AMEX for the period 1965-1989. All the constructed loser portfolios realize positive returns. What is more, Foltice & Langer (2015) assert the idea of individual investors to employ only a simplified momentum strategy or the so-called "buying the winners only" strategy. They refer to the unlimited risk, fees and the necessity for expertise and professionalism of the investors themselves, that short-selling involves. Foltice & Langer (2015) argue, that in the USA one of the biggest stock price momentum mutual fund families – AQR Capital Management, employs only long positions in past winners. That is why, we could conclude, that for the boom period on the BSE from Jan-2004 to Dec-2007 investors have had the opportunity to exploit momentum effect by only using long positions in past winner stocks, which requires small time commitment and very little knowledge of investing.

4.3. Momentum effect within the crisis subsample

Table 3 shows, that momentum effect disappears during periods of severe market declines, as already discussed in literature review. Surprisingly however, WML portfolio with ($K=1$; $J=1$) turns out to be a very profitable strategy, earning an average weekly return of 0.56% or 2.24% per month, but this result is statistically insignificant. However, it is an interesting observation, that both going long (0.39% and t -stat. = 1.4443) and short (-0.17% and t -stat. = -0.7157) contribute to this momentum profit. Table 3 shows, that the WML

profits are either highly negative or statistically insignificant from zero. The WML strategy, earning the highest loss, is ($K=8$; $J=1$). The loss amounts to -1.65% weekly (t -stat. = -6.1991). Loser portfolios tend to severely outperform past winner ones. This evidence, obtained for the BSE, is consistent with the findings of Daniel & Moskowitz (2016), who investigate the two momentum crashes in history, that have much in common. These are the period of the Great Depression (Jun-1932 to Dec-1939) and the Great Recession (Mar-2009 to Mar-2013). The authors have decided to start their investigation periods precisely in June 1932 and March 2009, because these periods represent the moment, when the market bottom has been reached. During these two periods of most severe financial crash in history momentum effect has underperform even the market. Over both of the examined periods Daniel & Moskowitz (2016) find, that losers outperform profits of winners more than twice.

Table 3: Average raw weekly returns and profits on winner, loser and winner-minus-loser (WML) portfolios in percent points (Jan-2008 to Dec-2012). T-statistics are also presented.

| | J | 1 | | 2 | | 4 | | 8 | | 13 | | 26 | | 39 | | 52 | |
|----|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|
| K | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 1 | Winners | 0.39% | 1.4443 | -0.22% | -0.9564 | -0.37% | -1.8617 | -0.40% | -2.2884 | -0.30% | -1.8100 | -0.24% | -1.4614 | -0.07% | -0.4691 | 0.05% | 0.4007 |
| | Losers | -0.17% | -0.7157 | 0.29% | 1.2795 | 0.21% | 0.9777 | 0.03% | 0.1269 | -0.05% | -0.2589 | -0.14% | -0.7384 | 0.01% | 0.0375 | 0.12% | 0.8903 |
| | WML | 0.56% | 1.9243 | -0.51% | -2.4068 | -0.58% | -4.9694 | -0.42% | -4.2570 | -0.25% | -2.6254 | -0.10% | -1.5703 | -0.08% | -1.7632 | -0.07% | -1.8093 |
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 2 | Winners | -0.51% | -2.1201 | -0.75% | -3.8342 | -0.63% | -3.4597 | -0.51% | -2.9606 | -0.37% | -2.2322 | -0.25% | -1.5228 | -0.04% | -0.3105 | 0.05% | 0.4654 |
| | Losers | 0.43% | 1.7003 | 0.57% | 2.3520 | 0.29% | 1.2652 | 0.12% | 0.5501 | 0.03% | 0.1352 | -0.11% | -0.5713 | 0.09% | 0.5622 | 0.14% | 1.0863 |
| | WML | -0.94% | -3.2411 | -1.33% | -6.3158 | -0.92% | -5.8404 | -0.63% | -4.7560 | -0.40% | -3.4845 | -0.14% | -1.9590 | -0.14% | -2.6217 | -0.09% | -1.8522 |
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 4 | Winners | -0.80% | -3.1651 | -0.89% | -4.2518 | -0.74% | -3.9632 | -0.47% | -2.7821 | -0.33% | -2.0078 | -0.21% | -1.2909 | -0.02% | -0.1149 | 0.11% | 1.0262 |
| | Losers | 0.68% | 2.6630 | 0.69% | 2.7406 | 0.33% | 1.3894 | 0.20% | 0.9015 | 0.02% | 0.1177 | -0.11% | -0.5600 | 0.10% | 0.6284 | 0.19% | 1.4354 |
| | WML | -1.48% | -5.1928 | -1.59% | -7.2208 | -1.07% | -5.9253 | -0.67% | -4.6062 | -0.36% | -2.9956 | -0.10% | -1.1963 | -0.12% | -1.8106 | -0.08% | -1.2705 |
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 8 | Winners | -0.90% | -4.3041 | -0.98% | -4.9768 | -0.70% | -3.8889 | -0.47% | -2.8312 | -0.32% | -2.0262 | -0.21% | -1.3317 | 0.04% | 0.3335 | 0.13% | 1.3260 |
| | Losers | 0.74% | 2.7496 | 0.65% | 2.4111 | 0.37% | 1.4941 | 0.12% | 0.5025 | -0.08% | -0.3786 | -0.10% | -0.5246 | 0.20% | 1.2912 | 0.24% | 1.7850 |
| | WML | -1.65% | -6.1991 | -1.63% | -6.7317 | -1.07% | -4.9861 | -0.58% | -3.0903 | -0.24% | -1.6427 | -0.10% | -0.9037 | -0.16% | -1.7763 | -0.11% | -1.3190 |
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 13 | Winners | -0.71% | -3.7641 | -0.74% | -4.2318 | -0.51% | -3.0222 | -0.33% | -2.0159 | -0.21% | -1.3588 | -0.13% | -0.8516 | -0.04% | -0.3374 | 0.08% | 0.8586 |
| | Losers | 0.51% | 1.9639 | 0.43% | 1.7052 | 0.24% | 1.0177 | -0.03% | -0.1345 | -0.12% | -0.5341 | -0.06% | -0.3217 | 0.14% | 0.8953 | 0.18% | 1.2819 |
| | WML | -1.23% | -4.7470 | -1.18% | -4.9468 | -0.75% | -3.4206 | -0.30% | -1.4182 | -0.10% | -0.5275 | -0.07% | -0.4486 | -0.18% | -1.5390 | -0.09% | -0.8895 |
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 26 | Winners | -0.30% | -1.5814 | -0.41% | -2.2877 | -0.31% | -1.7892 | -0.15% | -0.9007 | -0.04% | -0.2703 | -0.02% | -0.1689 | 0.07% | 0.6921 | 0.08% | 0.8041 |
| | Losers | 0.26% | 0.9858 | 0.25% | 0.9875 | 0.11% | 0.4463 | 0.04% | 0.1673 | 0.01% | 0.0387 | 0.11% | 0.5721 | 0.21% | 1.2102 | 0.12% | 0.7119 |
| | WML | -0.56% | -2.0451 | -0.67% | -2.5423 | -0.42% | -1.7141 | -0.19% | -0.8374 | -0.05% | -0.2455 | -0.13% | -0.7370 | -0.14% | -0.8506 | -0.04% | -0.2360 |
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 39 | Winners | -0.32% | -1.7650 | -0.33% | -1.9090 | -0.25% | -1.5680 | -0.02% | -0.1596 | -0.03% | -0.2028 | 0.04% | 0.3712 | 0.06% | 0.5527 | 0.01% | 0.0834 |
| | Losers | 0.37% | 1.4313 | 0.46% | 1.8486 | 0.32% | 1.3588 | 0.33% | 1.4534 | 0.21% | 0.9659 | 0.20% | 0.9925 | 0.18% | 0.9757 | 0.00% | 0.0221 |
| | WML | -0.69% | -2.6159 | -0.78% | -3.1250 | -0.57% | -2.3785 | -0.36% | -1.5433 | -0.24% | -1.0897 | -0.16% | -0.7951 | -0.13% | -0.6928 | 0.00% | 0.0312 |
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 52 | Winners | -0.12% | -0.7965 | -0.16% | -1.0540 | -0.06% | -0.4681 | 0.06% | 0.4631 | 0.08% | 0.7093 | 0.06% | 0.5699 | 0.02% | 0.1701 | 0.05% | 0.5660 |
| | Losers | 0.46% | 1.9400 | 0.46% | 1.9908 | 0.39% | 1.7281 | 0.36% | 1.6305 | 0.26% | 1.2148 | 0.13% | 0.6645 | 0.01% | 0.0743 | 0.02% | 0.1821 |
| | WML | -0.58% | -2.3068 | -0.62% | -2.5304 | -0.45% | -1.9108 | -0.30% | -1.3036 | -0.18% | -0.7816 | -0.07% | -0.3452 | 0.01% | 0.0355 | 0.03% | 0.1967 |

Let us look at the winner and loser portfolios, that both earn statistically significant returns for one and the same strategy (K ; J). These are the strategies ($K=2$; $J=2$), ($K=4$; $J=1$ and 2) and ($K=8$; $J=1$ and 2). It can be seen, that past winner stocks realize negative returns in the holding period. The losses vary between -0.98% for ($K=8$; $J=2$) and -0.75% for ($K=2$; $J=2$). On the other hand, past loser stocks remark highly positive returns during the holding period. The profits vary between 0.57% for ($K=2$; $J=2$) and 0.74% for ($K=8$; $J=1$). As a whole, the return of loser portfolios exceeds the one of winners by approximately 1.77 times or 77%. This figure has been obtained for each of the investigated five strategies by calculating the difference in the performance of the statistically significant winner and loser portfolios for one and the same combination (K ; J). For instance, for the combination ($K=4$; $J=2$) we calculate: $\frac{(0.69+0.89)}{0.89} = 1.78$. further calculations include:

- Combination ($K=2$; $J=2$): $\frac{(0.57+0.75)}{0.75} = 1.76$
- Combination ($K=4$; $J=1$): $\frac{(0.68+0.80)}{0.80} = 1.85$

- Combination ($K=8; J=1$): $\frac{(0.74+0.90)}{0.90} = 1.82$
- Combination ($K=8; J=2$): $\frac{(0.65+0.98)}{0.98} = 1.65$
- Average value: $\frac{1.76+1.85+1.78+1.82+1.65}{5} = 1.77$

4.4. Momentum effect within the post-crisis subsample

Examining the post-crisis period between Jan-2013 and Jul-2017, we intend to answer the question, if momentum effect has reappeared after the most negative period on the BSE, as expected by literature Chabot et al. (2014). Table 4 summarizes our findings. It can be seen, that momentum is still a losing strategy. The majority of WML profits are statistically insignificant, while the rest of them is insignificantly different from zero. Past losers always outperform past winners by severe amounts. The only exception of this pattern is WML portfolio ($K=1; J=1$), that yields a statistically significant 1.69% per week. Both of the winner and loser portfolio contribute to this profit, although the return of the past loser stocks is statistically insignificant.

If we consider transaction cost, charged by the investment brokers, this one-week strategy ($K=1; J=1$) turns out to be unprofitable. Firstly, each trade (long and short position) is charged individually at the beginning and at the end of each holding period. For instance, one of the biggest intermediaries Elana Trading (2017) charges 0.50% fee on the volume of each trade below 100,000 BGL and this occurs twice as discussed above. For our ($K=1; J=1$) strategy, earning 1.69%, this means transaction costs of 2% per week. Additionally, not all intermediaries in Bulgaria offer short selling, although it is recognized by law. What is more, poor liquidity could also hamper the one-week strategy. What is more, the poor liquidity on the BSE would also undermine the WML strategy ($K=1; J=1$).

Table 4: Average raw weekly returns and profits on winner, loser and winner-minus-loser (WML) portfolios in percent points (Jan-2013 to Jul-2017). T-statistics are also presented.

| K | J | 1 | | 2 | | 4 | | 8 | | 13 | | 26 | | 39 | | 52 | |
|----|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|
| | | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat | Return | t-stat |
| 1 | Winners | 1.54% | 7.8487 | 0.57% | 3.4378 | 0.23% | 1.3201 | 0.41% | 2.4895 | 0.45% | 3.1517 | 0.36% | 2.5145 | 0.21% | 1.6663 | 0.15% | 1.2777 |
| | Losers | -0.15% | -0.5215 | 0.93% | 3.3781 | 1.20% | 6.0208 | 0.89% | 5.1035 | 0.75% | 4.5517 | 0.46% | 3.3276 | 0.30% | 2.2719 | 0.21% | 1.6507 |
| | WML | 1.69% | 5.4500 | -0.36% | -1.3836 | -0.97% | -7.5699 | -0.48% | -7.2980 | -0.30% | -5.6276 | -0.10% | -3.2815 | -0.09% | -3.8109 | -0.06% | -3.0678 |
| 2 | Winners | 0.57% | 2.9310 | -0.02% | -0.0901 | 0.02% | 0.1174 | 0.30% | 1.7952 | 0.40% | 2.7944 | 0.32% | 2.3277 | 0.19% | 1.5687 | 0.13% | 1.2035 |
| | Losers | 1.22% | 4.1639 | 1.56% | 6.6283 | 1.47% | 7.8085 | 0.99% | 5.9809 | 0.79% | 4.8958 | 0.49% | 3.5058 | 0.31% | 2.4301 | 0.19% | 1.6231 |
| | WML | -0.65% | -2.0532 | -1.58% | -7.4207 | -1.44% | -8.4633 | -0.69% | -7.6065 | -0.39% | -6.1101 | -0.16% | -4.1149 | -0.12% | -3.7688 | -0.06% | -2.3898 |
| 4 | Winners | -0.24% | -1.3526 | -0.36% | -1.8738 | 0.00% | 0.0204 | 0.27% | 1.5707 | 0.36% | 2.3745 | 0.28% | 2.0239 | 0.18% | 1.3732 | 0.11% | 0.9572 |
| | Losers | 1.63% | 6.4330 | 1.74% | 8.3537 | 1.44% | 7.9590 | 0.99% | 6.3780 | 0.78% | 5.1940 | 0.43% | 3.3539 | 0.29% | 2.4420 | 0.17% | 1.5379 |
| | WML | -1.87% | -6.5940 | -2.10% | -9.5397 | -1.44% | -6.8929 | -0.72% | -6.2095 | -0.41% | -4.9744 | -0.15% | -2.8468 | -0.12% | -2.4619 | -0.06% | -1.7339 |
| 8 | Winners | -0.01% | -0.0487 | -0.19% | -1.0363 | 0.02% | 0.0942 | 0.35% | 2.0803 | 0.44% | 2.4163 | 0.29% | 1.8898 | 0.21% | 1.3991 | 0.12% | 0.9175 |
| | Losers | 1.63% | 6.2339 | 1.76% | 8.1913 | 1.44% | 7.7313 | 0.94% | 5.6448 | 0.64% | 4.4841 | 0.38% | 2.8715 | 0.27% | 2.2408 | 0.13% | 1.1623 |
| | WML | -1.64% | -6.0022 | -1.95% | -8.7552 | -1.42% | -6.8932 | -0.59% | -4.4906 | -0.20% | -1.5703 | -0.10% | -1.2151 | -0.06% | -0.8429 | -0.02% | -0.2855 |
| 13 | Winners | -0.09% | -0.5700 | -0.08% | -0.4656 | 0.11% | 0.6138 | 0.39% | 2.0369 | 0.39% | 1.9073 | 0.31% | 1.7418 | 0.20% | 1.2260 | 0.10% | 0.7167 |
| | Losers | 1.45% | 5.2266 | 1.52% | 6.6206 | 1.28% | 6.3622 | 0.78% | 4.8550 | 0.56% | 4.0501 | 0.33% | 2.4993 | 0.21% | 1.7783 | 0.08% | 0.7061 |
| | WML | -1.54% | -5.1923 | -1.59% | -7.4369 | -1.17% | -5.9063 | -0.40% | -2.3384 | -0.17% | -0.9705 | -0.02% | -0.2019 | -0.01% | -0.0825 | 0.02% | 0.2758 |
| 26 | Winners | 0.27% | 1.1709 | 0.21% | 0.9493 | 0.28% | 1.2761 | 0.40% | 1.8426 | 0.42% | 1.9457 | 0.34% | 1.6210 | 0.17% | 0.9133 | 0.21% | 1.2206 |
| | Losers | 0.87% | 4.9479 | 1.06% | 6.2066 | 0.86% | 5.3423 | 0.52% | 3.6224 | 0.40% | 2.9106 | 0.27% | 2.0742 | 0.10% | 0.8260 | 0.10% | 1.0632 |
| | WML | -0.61% | -2.5299 | -0.85% | -3.7730 | -0.58% | -2.7773 | -0.13% | -0.6647 | 0.03% | 0.1322 | 0.07% | 0.3750 | 0.08% | 0.4460 | 0.10% | 0.7005 |
| 39 | Winners | 0.08% | 0.4886 | 0.03% | 0.1786 | 0.13% | 0.7125 | 0.34% | 1.7267 | 0.37% | 1.8401 | 0.24% | 1.2568 | 0.23% | 1.2592 | 0.11% | 0.7010 |
| | Losers | 0.89% | 4.8196 | 0.96% | 5.2958 | 0.82% | 4.7594 | 0.49% | 3.3886 | 0.42% | 3.0605 | 0.22% | 1.5813 | 0.16% | 1.3873 | 0.07% | 0.7737 |
| | WML | -0.82% | -3.9073 | -0.93% | -4.5775 | -0.69% | -3.4014 | -0.16% | -0.8236 | -0.05% | -0.2825 | 0.02% | 0.1324 | 0.07% | 0.4272 | 0.04% | 0.2608 |
| 52 | Winners | 0.38% | 1.8184 | 0.33% | 1.6072 | 0.37% | 1.8027 | 0.39% | 1.9628 | 0.36% | 1.8116 | 0.34% | 1.7289 | 0.19% | 0.9608 | 0.14% | 0.8780 |
| | Losers | 0.78% | 4.2241 | 0.77% | 4.2038 | 0.63% | 3.5444 | 0.38% | 2.3638 | 0.30% | 1.9724 | 0.23% | 1.7025 | 0.13% | 1.0946 | 0.10% | 0.9298 |
| | WML | -0.39% | -1.7883 | -0.44% | -2.0713 | -0.27% | -1.2883 | 0.01% | 0.0526 | 0.06% | 0.3083 | 0.11% | 0.5679 | 0.06% | 0.3083 | 0.04% | 0.2972 |

Both in the crisis subsample on the BSE and in the post-crisis one the past loser portfolios severely outperform past winner ones. Loser portfolios tend to earn positive returns, while winner ones – negative or statistically insignificant from zero. Observing only statistically significant returns, it can be seen, that loser portfolios realize excessively high result on weekly basis, varying from 0.27% for ($K=8$; $J=39$) and ($K=26$; $J=26$) to 1.76% for ($K=8$; $J=2$). On the other hand, past winner portfolios realize a statistically significant return, varying between 0.28% for ($K=4$; $J=26$) and 1.54% for ($K=1$; $J=1$). However, we should emphasize, that only 13 out of a total 64 (K ; J) strategies, applied to the construction of winner portfolios, earn positive results. In comparison, 48 out of a total 64 past loser portfolios realize positive returns. This evidence is indicative for the superiority of past loser stocks over past winner ones during the holding period.

Overall, the observed findings in the post-crisis period indicate, that the BSE still suffers from the consequences of the GFC. That is why momentum has not yet reappeared. Our findings are consistent with these of Alphonse & Nguyen (2013) for the momentum on Vietnamese stock exchange. They also find, that momentum is confined to the period prior to the Lehmann shock and has vanished since then.

5. CONCLUSION

Momentum effect – one of the most researched market anomalies, that still challenges the Efficient Market Hypothesis by Eugene Fama, was present on the BSE during the pre-crisis period from Jan-2004 to Dec-2007. During that time span momentum trading strategies yielded significant returns with the highest of 1.46% per week and the most optimal of 1.34% per week. During the economic boom, we observe that the longer the formation period - K , the better the return predictability for the WML portfolio is, as J increases and tends to 52 weeks. Exception to this pattern is the strong future one-week return predictability based on the equal-termed past returns. The occurrence of the GFC and its strongly negative impact on the BSE has led to the disappearance of momentum effect, which is common in such market states. Up to date momentum has not reappeared on the BSE, which implicates, that the BSE is still undergoing the consequence of the Global Recession.

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APPENDIX A

| Stock № | Company name and code | Stock № | Company name and code |
|----------------|---|----------------|---|
| 1 | Sopharma AD-Sofia (3JR) | 45 | CBA Asset Management AD-Veliko Tarnovo (C81) |
| 2 | CB First Investment Bank AD-Sofia (5F4) | 46 | Tchaikapharma High Quality Medicines AD-Sofia (7TH) |
| 3 | CEZ Distribution Bulgaria AD-Sofia (3CZ) | 47 | CEZ Electro Bulgaria AD-Sofia (1CZ) |
| 4 | Monbat AD-Sofia (5MB) | 48 | Yuri Gagarin PLC-Plovdiv (4PX) |
| 5 | Chimimport AD-Sofia (6C4) | 49 | Bioiasis AD-Sofia (4OE) |
| 6 | M+S Hydraulic AD-Kazanlak (5MH) | 50 | Varna-Plod AD-Varna (4V5) |
| 7 | Alcomet AD-Shumen (6AM) | 51 | EMKA AD-Sevlievo (57E) |
| 8 | Sopharma Trading AD-Sofia (SO5) | 52 | Lavena AD-Shumen (4L4) |
| 9 | Albena AD-Albena (6AB) | 53 | Futures Capital AD-Sofia (5FC) |
| 10 | Speedy AD-Sofia (0SP) | 54 | BG Agro AD-Varna (AO0) |
| 11 | Eurohold Bulgaria AD-Sofia (4EH) | 55 | Billboard AD-Sofia (5BP) |
| 12 | CB Central Cooperative Bank AD-Sofia (4CF) | 56 | Bulgartabac Holding AD-Sofia (57B) |
| 13 | Holding Varna AD-Varna (5V2) | 57 | Bulgarian Private Equity Fund AD-Sofia (BPT) |
| 14 | Velgraf Asset Management AD-Sofia (1VX) | 58 | Elhim Iskra AD-Pazardzhik (52E) |
| 15 | Stara Planina Hold AD-Sofia (5SR) | 59 | Etropal AD-Etropole (5EO) |
| 16 | Galata Investment Company AD-Varna (GTH) | 60 | Energoremont Holding AD-Sofia (6EG) |
| 17 | Himsnab Bulgaria AD-Sofia (58E) | 61 | Bulstrad Vienna Insurance Group AD-Sofia (4BI) |
| 18 | Industrial Holding Bulgaria PLC-Sofia (4ID) | 62 | Euroins Insurance Group AD-Sofia (5IC) |
| 19 | CB Texim Bank AD-Sofia (5CP) | 63 | Zlatni Pyasatsi AD-Varna (3ZL) |
| 20 | Sirma Group Holding JSC-Sofia (SKK) | 64 | Zarneni Hrani Bulgaria AD-Sofia (T43) |
| 21 | Holding Nov Vek AD-Sofia (6N3) | 65 | Industrial Capital Holding AD-Sofia (4I8) |
| 22 | Odessos Shiprepair Yard AD-Varna (5ODE) | 66 | Investor.BG AD-Sofia (4IN) |
| 23 | Regala Invest AD-Varna (RGL) | 67 | Industrial Holding Bulgaria PLC-Sofia (4ID) |
| 24 | Doverie United Holding PLC-Sofia (5DOV) | 68 | Kauchuk AD-Sofia (4KU) |
| 25 | Bulgarian Stock Exchange-Sofia (BSO) | 69 | IHB Electric AD-Sofia (55E) |
| 26 | Elana Agrocredit AD-Sofia (0EA) | 70 | Korado Bulgaria AD-Strazhitsa (4KX) |
| 27 | Agria Group Holding AD-Varna (A72) | 71 | Lomsko Pivo AD-Lom (6L1) |

| | | | |
|----|--|----|---|
| 28 | Advance Equity Holding AD-Sofia (6A8) | 72 | Momina Krepost AD-Veliko Tarnovo (5MR) |
| 29 | Allterco AD-Sofia (A4L) | 73 | Concord Fund-7 South-East Europe (CODA) |
| 30 | Aroma AD-Sofia (6AR) | 74 | Neochim AD-Dimitrovgrad (3NB) |
| 31 | Asenova Krepost AD-Asenovgrad (6AN) | 75 | Bulgarian River Shipping AD-Ruse (5BR) |
| 32 | Sparky Eltos AD-Lovech (SL9) | 76 | Petrol AD-Sofia (5PET) |
| 33 | CB Bulgarian American Credit Bank AD-Sofia (5BN) | 77 | Oil and Gas Exploration and Production AD-Sofia (401) |
| 34 | TK-Hold PLC-Sofia (T24) | 78 | Real Bulland JSC-Sofia (RBL) |
| 35 | Todoroff AD-Sofia (5T6) | 79 | SS Konstantine And Elena Holding AD-Varna (3NJ) |
| 36 | Toplivo AD-Sofia (3TV) | 80 | Svilosa AD-Svishtov (3MZ) |
| 37 | Trace Group Hold AD-Sofia (T57) | 81 | Severcoop Gamza Holding AD-Sofia 6S4 |
| 38 | Unipack AD-Pavlikeni (3U9) | 82 | Sila Holding AD-Stara Zagora (6S5) |
| 39 | Unipharm AD-Sofia (59X) | 83 | Synergon Holding AD-Sofia (6S7) |
| 40 | Favorit Hold AD-Sofia (6A9) | 84 | Synthetica AD-Sofia (EHN) |
| 41 | Fazerles AD-Silistra (4F6) | 85 | Slanchev Bryag AD-Slanchev Bryag (3JL) |
| 42 | Formoplast AD-Kardzhali (4F8) | 86 | Solarpro Holding AD-Sofia (0S8) |
| 43 | Hydraulic Elements and Systems AD-Yambol (4HE) | 87 | Sofia Commerce-Pawn Brokerage AD-Sofia (6SOA) |
| 44 | Hydroizomat AD-Sofia (4HI) | 88 | Sofia Commerce-Pawn Brokerage AD-Sofia (6SOP) |

APPENDIX B

Figure B1: Stock price dynamics of stocks 1-9. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

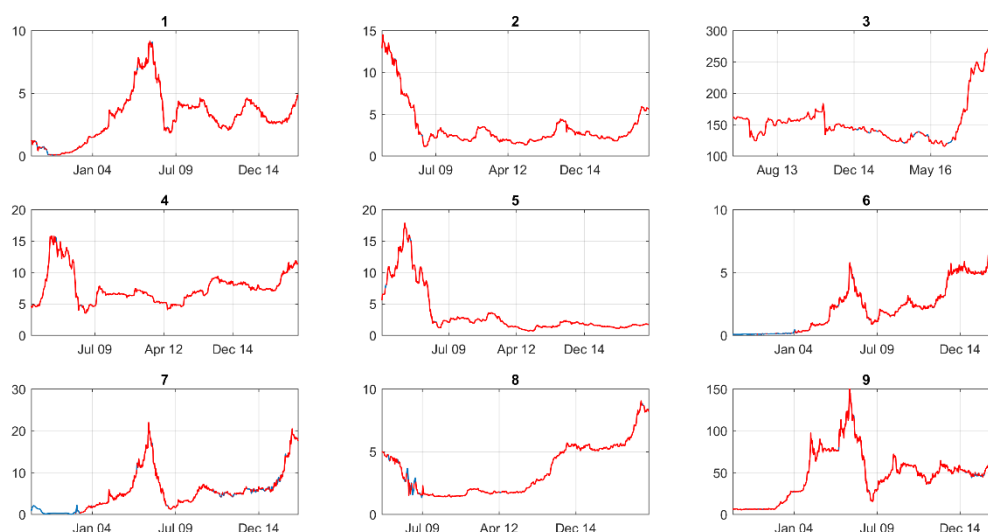


Figure B2: Stock price dynamics of stocks 10-18. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

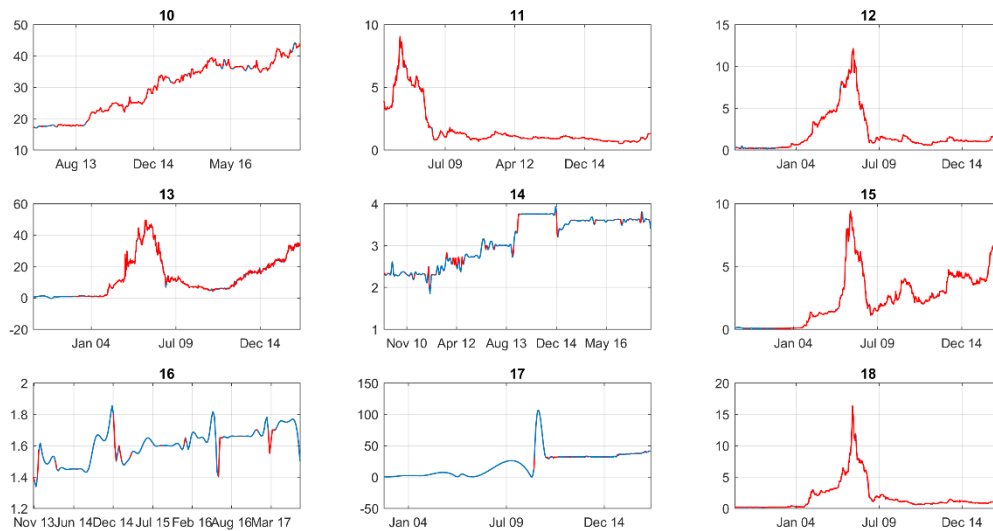


Figure B3: Stock price dynamics of stocks 19-27. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

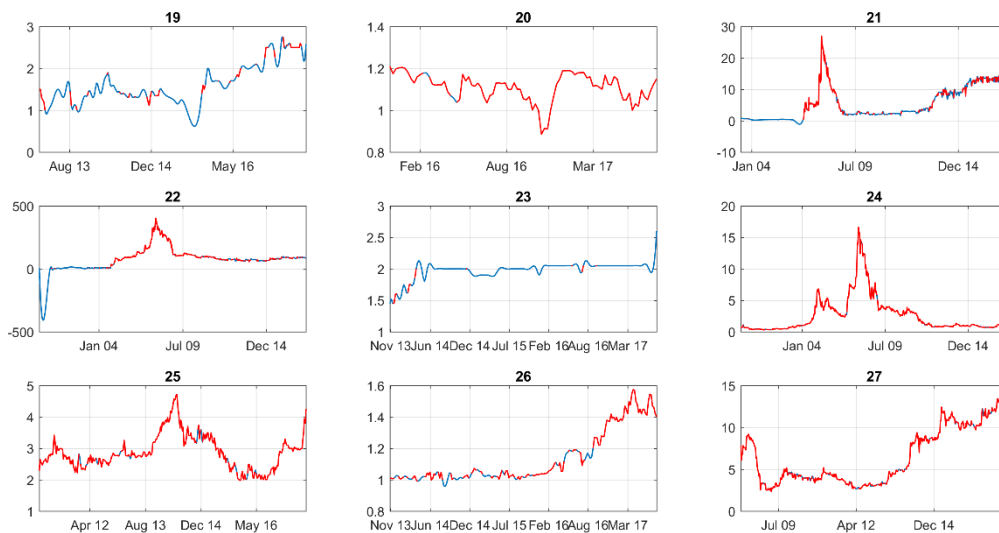


Figure B4: Stock price dynamics of stocks 28-36. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

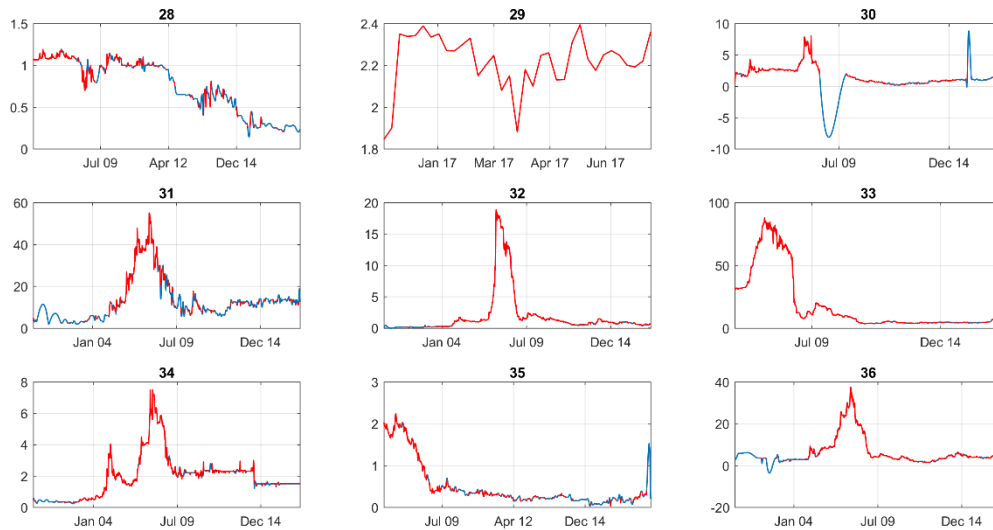


Figure B5: Stock price dynamics of stocks 37-45. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

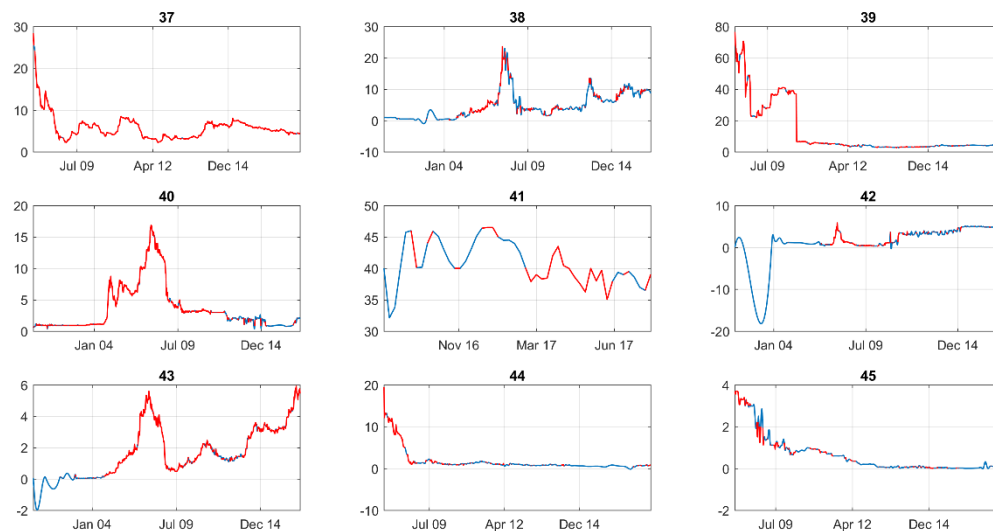


Figure B6: Stock price dynamics of stocks 46-54. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

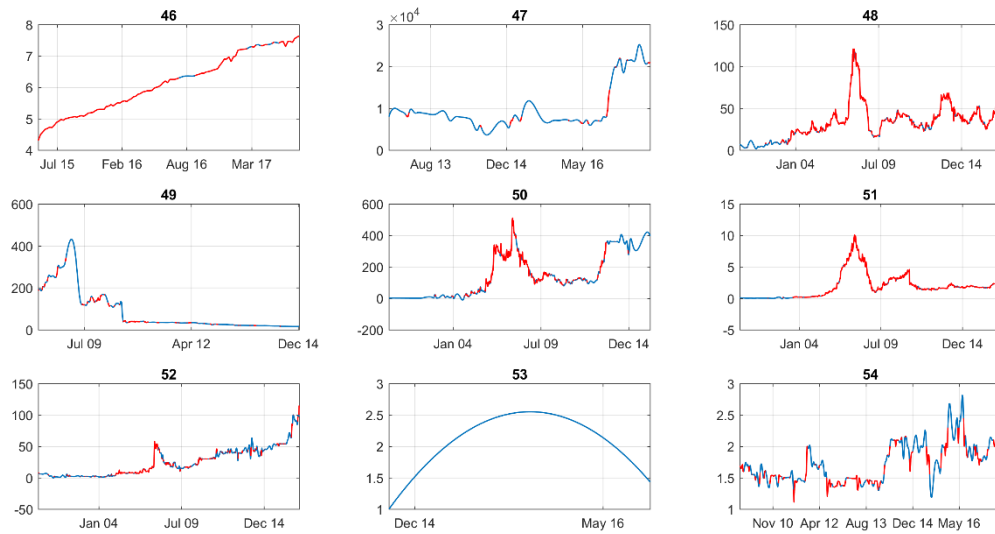


Figure B7: Stock price dynamics of stocks 55-63. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

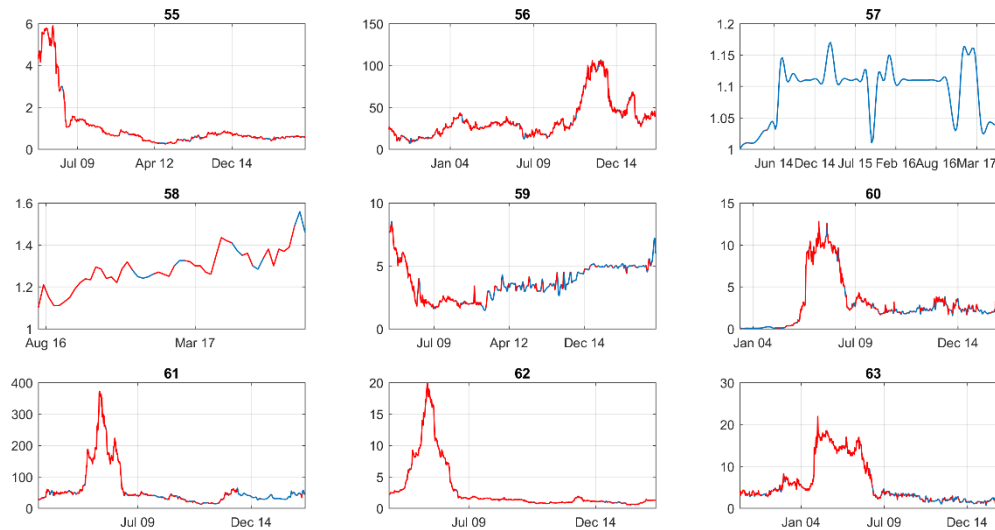


Figure B8: Stock price dynamics of stocks 64-72. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

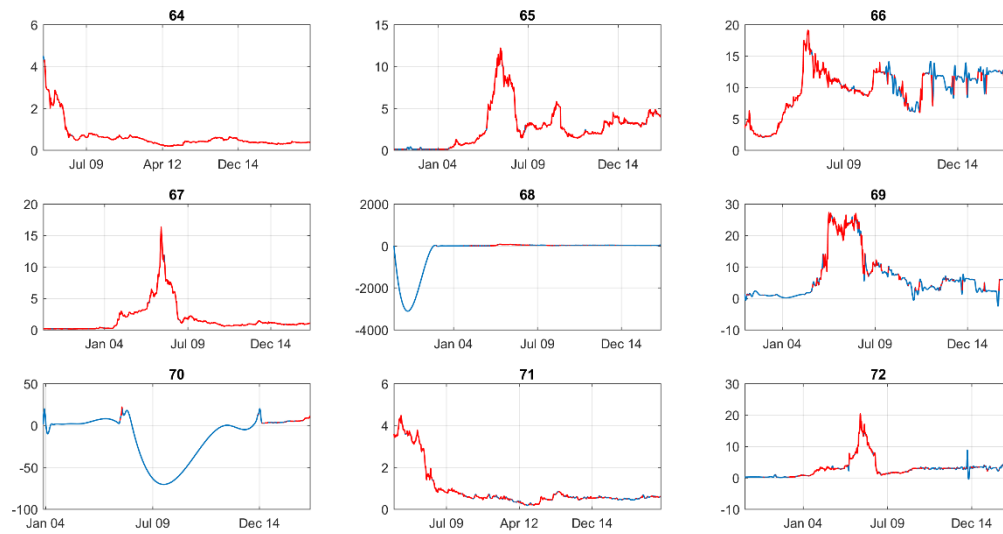


Figure B9: Stock price dynamics of stocks 10-18. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

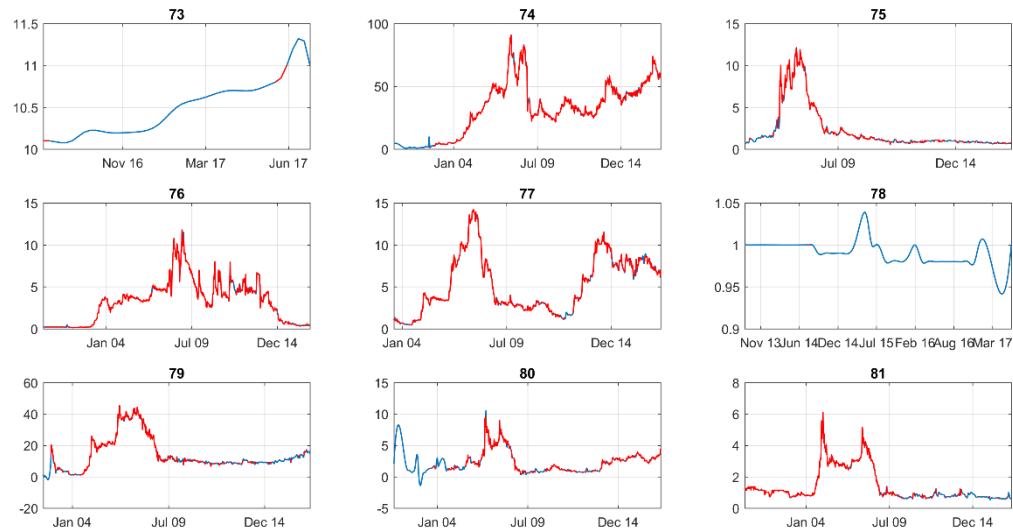
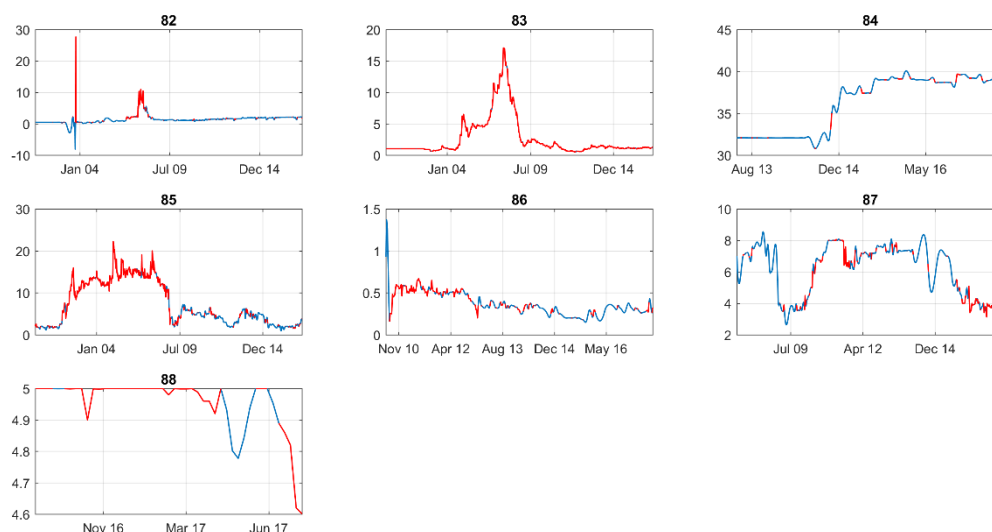


Figure B10: Stock price dynamics of stocks 82-88. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.



APPENDIX C

| Stock № | Company name and code | Stock № | Company name and code |
|---------|---|---------|---|
| 1 | Sopharma AD-Sofia (3JR) | 36 | Fazerles AD-Silistra (4F6) |
| 2 | CB First Investment Bank AD-Sofia (5F4) | 37 | Hydraulic Elements and Systems AD-Yambol (4HE) |
| 3 | CEZ Distribution Bulgaria AD-Sofia (3CZ) | 38 | Tchaikapharma High Quality Medicines AD-Sofia (7TH) |
| 4 | Monbat AD-Sofia (5MB) | 39 | Yuri Gagarin PLC-Plovdiv (4PX) |
| 5 | Chimimport AD-Sofia (6C4) | 40 | Varna-Plod AD-Varna (4V5) |
| 6 | M+S Hydraulic AD-Kazanlak (5MH) | 41 | EMKA AD-Sevlievo (57E) |
| 7 | Alcomet AD-Shumen (6AM) | 42 | Lavena AD-Shumen (4L4) |
| 8 | Sopharma Trading AD-Sofia (SO5) | 43 | BG Agro AD-Varna (AO0) |
| 9 | Albena AD-Albena (6AB) | 44 | Billboard AD-Sofia (5BP) |
| 10 | Speedy AD-Sofia (0SP) | 45 | Bulgartabac Holding AD-Sofia (57B) |
| 11 | Eurohold Bulgaria AD-Sofia (4EH) | 46 | Elhim Iskra AD-Pazardzhik (52E) |
| 12 | CB Central Cooperative Bank AD-Sofia (4CF) | 47 | Etropal AD-Etropole (5EO) |
| 13 | Holding Varna AD-Varna (5V2) | 48 | Energoremont Holding AD-Sofia (6EG) |
| 14 | Stara Planina Hold AD-Sofia (5SR) | 49 | Bulstrad Vienna Insurance Group AD-Sofia (4BI) |
| 15 | Industrial Holding Bulgaria PLC-Sofia (4ID) | 50 | Euroins Insurance Group AD-Sofia (5IC) |
| 16 | Sirma Group Holding JSC-Sofia (SKK) | 51 | Zlatni Pyasatsi AD-Varna (3ZL) |
| 17 | Holding Nov Vek AD-Sofia (6N3) | 52 | Zarneni Hrani Bulgaria AD-Sofia (T43) |
| 18 | Odessos Shiprepair Yard AD-Varna (5ODE) | 53 | Industrial Capital Holding AD-Sofia (4I8) |
| 19 | Doverie United Holding PLC-Sofia (5DOV) | 54 | Investor.BG AD-Sofia (4IN) |
| 20 | Bulgarian Stock Exchange-Sofia (BSO) | 55 | Industrial Holding Bulgaria PLC-Sofia (4ID) |
| 21 | Elana Agrocredit AD-Sofia (0EA) | 56 | IHB Electric AD-Sofia (55E) |
| 22 | Agria Group Holding AD-Varna (A72) | 57 | Lomsko Pivo AD-Lom (6L1) |

| | | | |
|----|--|----|---|
| 23 | Advance Equity Holding AD-Sofia (6A8) | 58 | Momina Krepost AD-Veliko Tarnovo (5MR) |
| 24 | Allterco AD-Sofia (A4L) | 59 | Neochim AD-Dimitrovgrad (3NB) |
| 25 | Aroma AD-Sofia (6AR) | 60 | Bulgarian River Shipping AD-Ruse (5BR) |
| 26 | Asenova Krepost AD-Asenovgrad (6AN) | 61 | Petrol AD-Sofia (5PET) |
| 27 | Sparky Eltos AD-Lovech (SL9) | 62 | Oil and Gas Exploration and Production AD-Sofia (401) |
| 28 | CB Bulgarian American Credit Bank AD-Sofia (5BN) | 63 | SS Konstantine And Elena Holding AD-Varna (3NJ) |
| 29 | TK-Hold PLC-Sofia (T24) | 64 | Svilosa AD-Svishtov (3MZ) |
| 30 | Todoroff AD-Sofia (5T6) | 65 | Severcoop Gamza Holding AD-Sofia 6S4 |
| 31 | Toplivo AD-Sofia (3TV) | 66 | Synergon Holding AD-Sofia (6S7) |
| 32 | Trace Group Hold AD-Sofia (T57) | 67 | Slanchev Bryag AD-Slanchev Bryag (3JL) |
| 33 | Unipack AD-Pavlikeni (3U9) | 68 | Solarpro Holding AD-Sofia (0S8) |
| 34 | Unipharm AD-Sofia (59X) | 69 | Sofia Commerce-Pawn Brokerage AD-Sofia (6SOP) |
| 35 | Favorit Hold AD-Sofia (6A9) | | |

APPENDIX D

Figure D1: Stock price dynamics of stocks 1-9. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

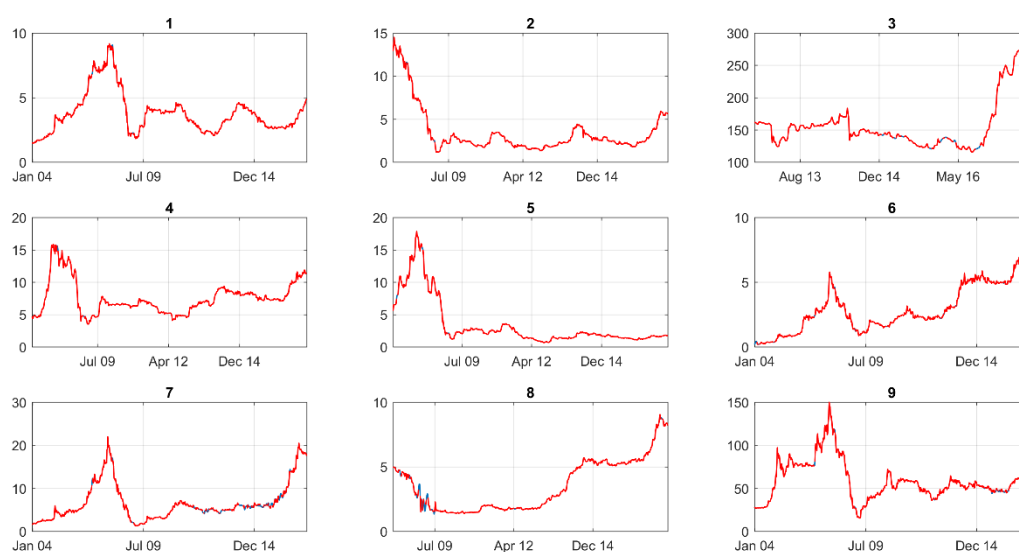


Figure D2: Stock price dynamics of stocks 10-18. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

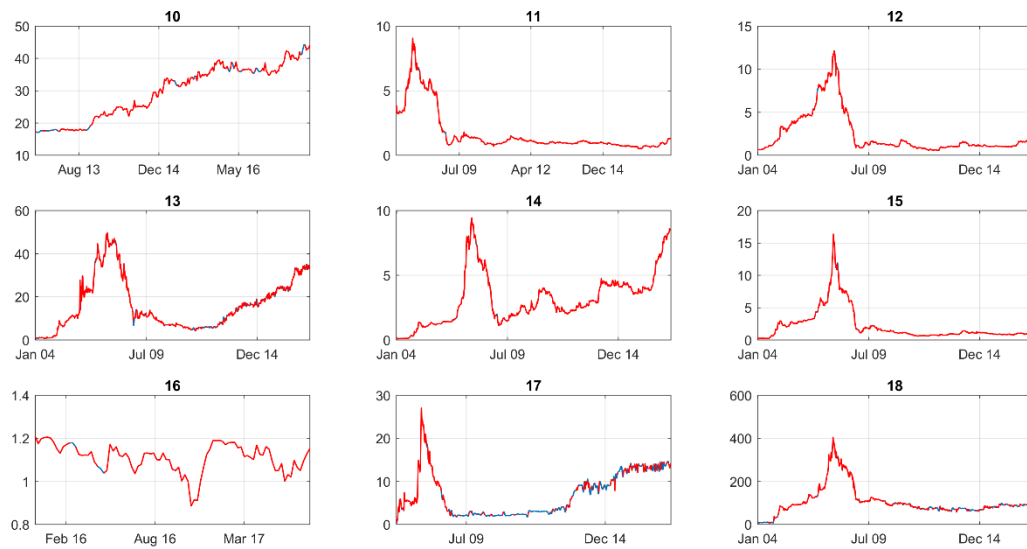


Figure D3: Stock price dynamics of stocks 19-26. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

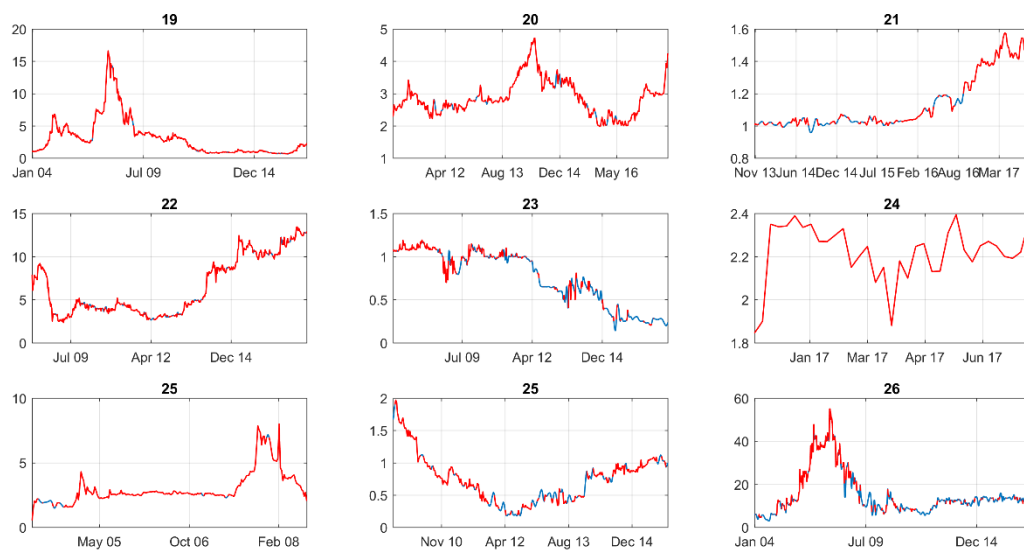


Figure D4: Stock price dynamics of stocks 27-35. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

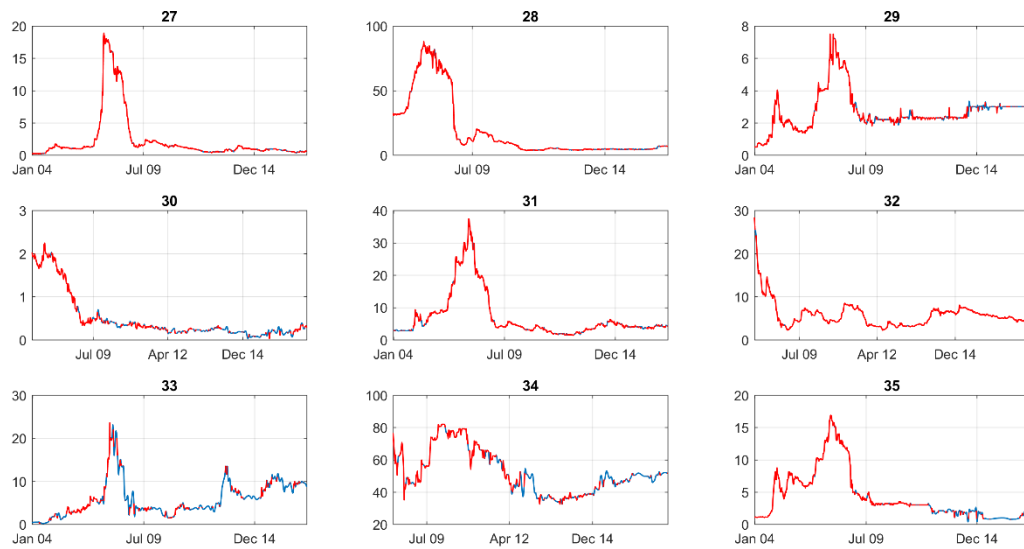


Figure D5: Stock price dynamics of stocks 36-44. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

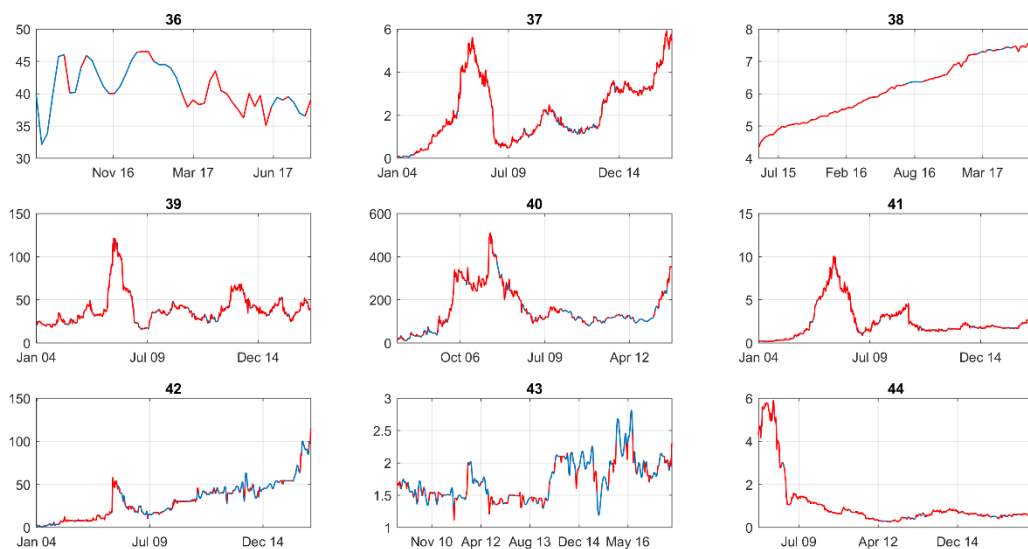


Figure D6: Stock price dynamics of stocks 45-53. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

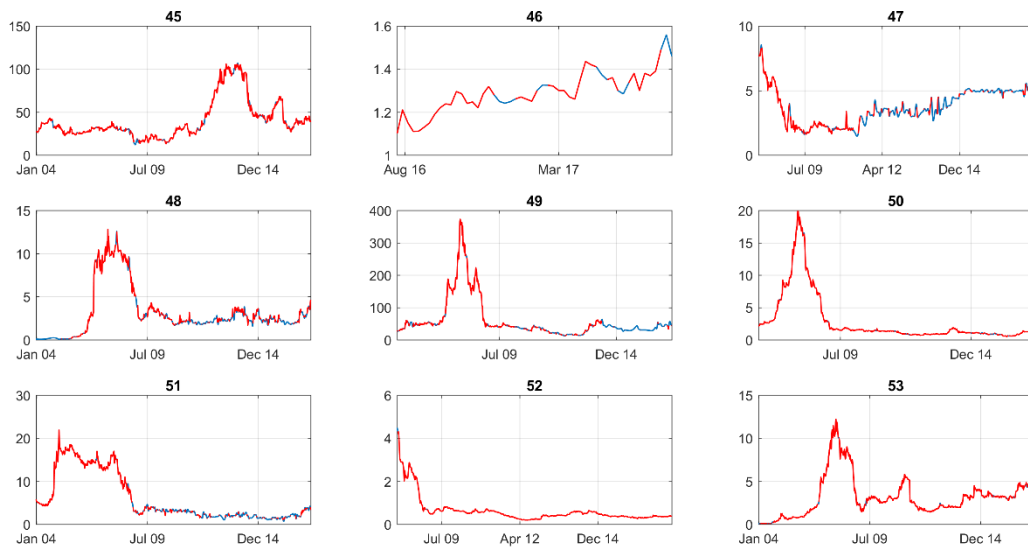


Figure D7: Stock price dynamics of stocks 54-62. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

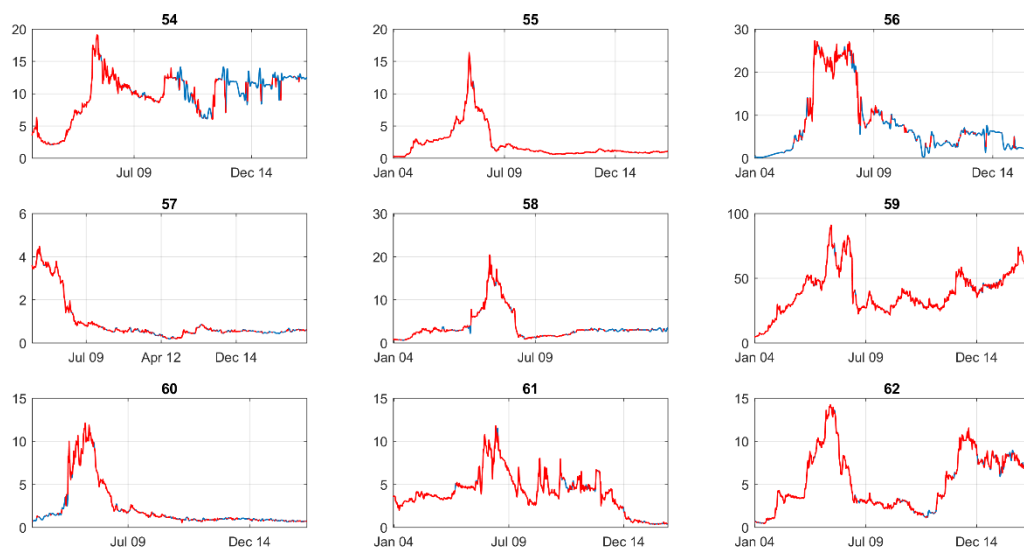


Figure D8: Stock price dynamics of stocks 63-69. The red line depicts the stock price movements for the period spanning from the first to last trading date while the blue line represents the fitted spline interpolation when filling missing values.

